Comparison of Catch Reporting Systems for Commercial Salmon Fisheries in British Columbia

L. Bijsterveld, S. Di Novo, A. Fedorenko, and L. Hop Wo

Fisheries and Oceans Canada
South Coast Division
3225 Stephenson Pt. Road
Nanaimo, B.C. V9T 1K3

2002

Canadian Manuscript Report of Fisheries and Aquatic Sciences 2626

Fisheries and Oceans / Pêches et Océans

Canada

Canadian Manuscript Report of Fisheries and Aquatic Sciences

Manuscript reports contain scientific and technical information that contributes to existing knowledge but which deals with national or regional problems. Distribution is restricted to institutions or individuals located in particular regions of Canada. However, no restriction is placed on subject matter, and the series reflects the broad interests and policies of the Department of Fisheries and Oceans, namely, fisheries and aquatic sciences.

Manuscript reports may be cited as full publications. The correct citation appears above the abstract of each report. Each report is abstracted in *Aquatic Sciences and Fisheries Abstracts* and indexed in the Department's annual index to scientific and technical publications.

Numbers 1-900 in this series were issued as Manuscript Reports (Biological Series) of the Biological Board of Canada, and subsequent to 1937 when the name of the Board was changed by Act of Parliament, as Manuscript Reports (Biological Series) of the Fisheries Research Board of Canada. Numbers 1426 - 1550 were issued as Department of Fisheries and the Environment, Fisheries and Marine Service Manuscript Reports. The current series name was changed with report number 1551.

Manuscript reports are produced regionally but are numbered nationally. Requests for individual reports will be filled by the issuing establishment listed on the front cover and title page. Out-of-stock reports will be supplied for a fee by commercial agents.

Rapport manuscrit canadien des sciences halieutiques et aquatiques

Les rapports manuscrits contiennent des renseignements scientifiques et techniques qui constituent une contribution aux connaissances actuelles, mais qui traitent des problèmes nationaux ou régionaux. La distribution en est limitée aux organismes et aux personnes de régions particulières du Canada. Il n'y a aucune restriction quant au sujet; de fait, la série reflète la vaste gamme des intérêts et des politiques du ministère des Pêches et des Océans, c'est-à-dire les sciences halieutiques et aquatiques.

Les rapports manuscrits peuvent être cités comme des publications complètes. Le titre exact paraît au-dessus du résumé de chaque rapport. Les rapports manuscrits sont résumés dans la revue *Résumés des sciences aquatiques et halieutiques*, et ils sont classés dans l'index annual des publications scientifiques et techniques du Ministère.

Les numéros 1 à 900 de cette série ont été publiés à titre de manuscrits (série biologique) de l'Office de biologie du Canada, et après le changement de la désignation de cet organisme par décret du Parlement, en 1937, ont été classés comme manuscrits (série biologique) de l'Office des recherches sur les pêcheries du Canada. Les numéros 901 à 1425 ont été publiés à titre de rapports manuscrits de l'Office des recherches sur les pêcheries du Canada. Les numéros 1426 à 1550 sont parus à titre de rapports manuscrits du Service des pêches et de la mer, ministère des Pêches et de l'Environnement. Le nom actuel de la série a été établi lors de la parution du numéro 1551.

Les rapports manuscrits sont produits a l'échelon régional, mais numérotés à l'échelon national. Les demandes de rapports seront satisfaites par l'établissement auteur dont le nom figure sur la couverture et la page du titre. Les rapports épuisés seront fournis contre rétribution par des agents commerciaux.

103-02744/

Canadian Manuscript Report of Fisheries
and Aquatic Sciences 2626

2002

COMPARISON OF CATCH REPORTING SYSTEMS FOR COMMERCIAL SALMON FISHERIES IN BRITISH COLUMBIA

by

L. Bijsterveld[1], S. Di Novo, A. Fedorenko[2], and L. Hop Wo

Fisheries and Oceans Canada
South Coast Division
3225 Stephenson Pt. Road
Nanaimo, B.C. V9T 1K3

[1] Fisheries and Oceans Canada
Regional Data Unit
Suite 200 - 401 Burrard Street
Vancouver, B.C.
V6C 3S4

[2] Contract Fisheries Biologist,
Vancouver, B.C.

© Her Majesty the Queen in Right of Canada, 2002.
Cat. No. Fs 97-4/2626E ISSN 0706-6473

Correct citation for this publication:

Bijsterveld, L., S. Di Novo, A. Fedorenko, and L. Hop Wo. 2002. Comparison of catch reporting systems for commercial salmon fisheries in British Columbia. Can. Manuscr. Rep. Fish. Aquat. Sci. 2626: 44p.

TABLE OF CONTENTS

LIST OF FIGURES iv
LIST OF TABLES iv
LIST OF APPENDICES v
ABSTRACT vi
RÉSUMÉ vii
1. INTRODUCTION 1
2. CURRENT SALMON CATCH REPORTING SYSTEMS 2
Data Accuracy and Precision 2
Program Description 3
3. DATA USES 4
4. 2000 SALMON AUDIT 6
Audit Methodology 6
Audit Results 7
5. COMPARISON OF DIFFERENT CATCH REPORTING SYSTEMS 9
Investigation Results 9
Summary of Investigation Results 17
6. DISCUSSION 17
Problems With Different Salmon Catch Reporting Systems 17
Data requirements 19
Audit Requirements 25
Other Issues 25
7. RECOMMENDATIONS 26
ACKNOWLEDGEMENTS 30
REFERENCES 30
APPENDICES 31

LIST OF FIGURES

Figure 1. Comparison of expanded sockeye catch estimates (in-season, observer, logbook) and unexpanded sales slip estimates by Licence Area, 2000 South Coast commercial fisheries (data as of Dec. 31, 2001). 11

Figure 2. Vessel reporting compliance with respect to logbook phone-ins / mail-ins and sales slips for sockeye catches, 2000 South Coast commercial fisheries (data as of Dec.31, 2001). 13

Figure 3. Comparison of unexpanded sockeye catches for those vessels and vessels-days with all records (observer, logbook phone-ins / mail-ins and sales slips), 2000 South Coast commercial fisheries (data as of Dec. 31, 2001). 14

Figure 4. Comparison of average round weights of sockeye salmon based on sales slip data and MRP data, 2000 South Coast commercial fisheries. 23

LIST OF TABLES

Table 1. Preliminary comparison of in-season catch estimates and sales slip data for Fraser River sockeye, 2000 South Coast commercial fisheries (data as of Feb. 8, 2001). Area 23 Barkley Sound sockeye are excluded. 2

Table 2. Comparison of major catch reporting programs used in commercial salmon fisheries in B.C. 3

Table 3. Mailings and responses by Licence Area for 2000 salmon audit. 6

Table 4. "New" sales slip catch information for 2000 salmon audit. 7

Table 5. Unexpanded Fraser sockeye catch by Licence Area and statistical week for three data sources (logbook phone-ins, mail-ins, sales slips), 2000 South Coast commercial fisheries (catch records as of May 17 and Dec. 31, 2001). Area 23 Barkley Sound sockeye are excluded. 8

Table 6. Final comparison of in-season catch estimates and sales slip data for all South Coast sockeye, 2000 commercial fisheries (data as of Dec. 31, 2001). 10

Table 7. Sales slip catch components for sockeye by fishery type (research, test, commercial), 2000 South Coast commercial fisheries (data as of Dec. 31, 2001). 10

Table 8. Comparison of expanded sockeye catch estimates (in-season, observer and logbook phone-in) and unexpanded sockeye sales slip catch by Licence Area, 2000 South Coast commercial fisheries (data as of Dec. 31, 2001). 11

Table 9. Difference between highest and lowest catch estimates for 2000 salmon audit. 12

Table 10. Vessel reporting compliance with respect to logbook phone-ins, logbook mail-ins and sales slips for sockeye catches, 2000 South Coast commercial fisheries (data as of Dec. 31, 2001). 13

Table 11. Relationship between unexpanded catch and number of vessels reporting, 2000 South Coast commercial fisheries. 14

LIST OF TABLES (CONTINUED)

Table 12. Comparison of unexpanded sockeye catches for those vessels and vessels-days with all records (observer, logbook phone-ins / mail-ins and sales slips), 2000 South Coast commercial fisheries (data as of Dec. 31, 2001). 15

Table 13. Difference between the overall expanded observer and logbook catch estimates by species for 1999 and 2000 South Coast commercial salmon fisheries.....16

Table 14. Impact of different sources of error on major catch reporting programs used in commercial salmon fisheries (impact rated as **X** = major, x = minor, - nil). 17

Table 15. Preliminary data standards and the ability of present catch monitoring tools to address them (**X** addresses fully, x addresses partially, - not at all). 22

Table 16. Comparison of average round weights of sockeye salmon based on sales slip data and on MRP in-season biological samples, 2000 South Coast commercial fisheries. 24

Table 17. Difference in average sockeye weights based on sales slip data and MRP data. 25

LIST OF APPENDICES

Appendix 1. Commercial salmon fishing Licence Areas for South Coast of British Columbia. .31

Appendix 2. Salmon Gillnet Logbook Form. 34

Appendix 3. Salmon Seine Logbook Form. 35

Appendix 4. Salmon Troll Logbook Form. 36

Appendix 5. Cash Small Sales Slip. 37

Appendix 6. Cash Large Sales Slip. 38

Appendix 7. Supplementary monitoring tools. 39

Appendix 8. Individual records of unexpanded sockeye catches for those vessels and vessels-days with all records (observer, logbook phone-ins / mail-ins and sales slips), 2000 South Coast commercial fisheries (data as of Dec. 31, 2001). 40

Appendix 9. Comparison of expanded observer and logbook catch estimates by species and Licence Area, South/Central Coast commercial salmon fisheries, 1999 and 2000. 42

Appendix 10. Comparison of expanded observer and logbook catch estimates by species, South/Central Coast commercial salmon fisheries, 1999 and 2000. 43

Appendix 11. Comparison of average sockeye weights (lbs) based on sales slip data and MRP data. 44

ABSTRACT

Bijsterveld, L., S. Di Novo, A. Fedorenko, and L. Hop Wo. 2002. Comparison of catch reporting systems for commercial salmon fisheries in British Columbia. Can. Manuscr. Rep. Fish. Aquat. Sci. 2626: 44p.

For the year 2000 South Coast commercial fisheries, significant discrepancies were observed between the in-season catch estimates and post-season sales slip catch totals. Specifically, the preliminary data for sockeye salmon showed that the total sales slip catch was lower than the estimated in-season catch by 234,000 pieces (24%). This triggered an in-depth investigation by Fisheries and Oceans Canada of the major catch reporting programs (observer, logbook and sales slip) for the 2000 commercial sockeye fisheries. The goal was to quantify the full extent of the discrepancies and identify the sources of error.

The results showed that the absolute sales slip totals routinely underestimated the sockeye catch, compared to the observer and logbook catch estimates. As well, all species of salmon may show significant discrepancies between the expanded observer and expanded logbook catch estimates; these discrepancies tend to be more pronounced (up to 51%) for the less abundant, non-target species (chinook, coho, steelhead). Vessel reporting compliance was lowest for logbook mail-ins compared to phone-ins or sales slip submissions (606, 909 and 954 reporting vessels, respectively). Troll fisheries showed a marked delay in sales slip catch reporting compared to observer and logbook phone-in / mail-in reporting.

Sources of error for the various discrepancies included non-compliance, incomplete or biased reporting, misreporting, data misinterpretation, small sample size and inaccurate total fishing effort. The conversion of sales slip landed weights to pieces was also a concern due to possible serious under- or over-estimation of total pieces landed. Recommendations were made to improve the current catch reporting system for future fisheries.

RÉSUMÉ

Bijsterveld, L., S. Di Novo, A. Fedorenko, and L. Hop Wo. 2002. Comparison of catch reporting systems for commercial salmon fisheries in British Columbia. Can. Manuscr. Rep. Fish. Aquat. Sci. 2626: 44p.

En ce qui concerne les pêches commerciales sur la côte sud de la Colombie-Britannique en 2000, des écarts importants ont été observés entre les estimations des prises faites en saison et le total des prises établi d'après les bordereaux d'achat à la fin de la saison. Plus particulièrement, les données préliminaires pour le saumon rouge indiquaient que le total des prises d'après les bordereaux était de 234 000 individus (24 %) moins élevé que l'estimation faite en saison, ce qui a déclenché un examen approfondi par Pêches et Océans Canada des principaux programmes de déclaration des prises (observateurs, journaux de bord et bordereaux d'achat) visant les pêches commerciales du saumon rouge en 2000. L'objectif de cet examen était de quantifier la pleine ampleur des écarts et d'identifier les sources d'erreur.

Les résultats de l'examen ont révélé que le total absolu des prises indiqué sur les bordereaux d'achat donnait régulièrement une sous-estimation des prises de saumon rouge, en comparaison des estimations des prises d'après les programmes des observateurs et les journaux de bord. En outre, des écarts importants entre les estimations des prises issues des programmes élargis des observateurs et des journaux de bord peuvent se produire dans le cas de toutes les espèces de saumon; ces écarts ont tendance à être plus marqués (jusqu'à 51 %) dans le cas des espèces-cibles moins abondantes (quinnat, coho, arc-en-ciel). Les journaux de bord envoyés par la poste affichaient le plus faible niveau de conformité à l'exigence de déclaration des prises, en comparaison des prises déclarées par téléphone ou établies d'après les bordereaux d'achat (606, 909 et 954 bateaux, respectivement). La déclaration des prises à la traîne par bordereaux d'achat accusait un retard marqué en comparaison de la déclaration des prises par les observateurs et des prises des journaux de bord faite par les pêcheurs par téléphone ou par courrier.

Parmi les sources d'erreur à l'origine des écarts s'inscrivent l'inobservation de la réglementation, la déclaration incomplète, biaisée ou erronée des prises, une mauvaise interprétation des données, la faible taille des échantillons et un effort de pêche total inexact. La conversion du poids au débarquement inscrit sur les bordereaux d'achat en nombre de saumons était aussi une source d'inquiétude à cause de la possibilité d'une sous-estimation ou d'une surestimation marquée du nombre total de saumons débarqués. Des recommandations sont présentées pour améliorer le système de déclaration des prises en place afin d'éviter de tels problèmes à l'avenir.

1. INTRODUCTION

Timely and accurate catch monitoring and reporting programs are vital to the proper assessment, management and enforcement of fisheries in order to ensure the conservation of fisheries resource and its long-term sustainability. As well, these programs assist in promoting trust among users, and provide assurance to the general public and environmental organizations that fisheries are being managed in a responsible fashion.

Outside organizations such as the Auditor General and the Pacific Fisheries Resource Conservation Council, conclude that some current catch monitoring and reporting systems are inadequate for Fisheries and Oceans Canada (DFO) to achieve its conservation goals; this is in spite of extensive resources and effort devoted to catch monitoring and reporting in these fisheries (Fisheries and Oceans Canada 2002). In January 2002, DFO released a Fishery Monitoring Framework to facilitate a review of the current catch monitoring and reporting systems in the Pacific Region (Fisheries and Oceans Canada 2002). The objective of that review is to identify the necessary improvements to these systems to better meet the needs of the resource and of all interested sectors (governments, First Nations, stakeholders, general public and international agencies).

History of Commercial Salmon Catch Monitoring

In the Pacific Region, official salmon catch reporting had been in place since the early 1950s. This took the form of landing reports known as sales slips (records of transaction between fishermen and buyers) which were completed when fishermen made deliveries to processing plants. Deliveries and landing reports were typically completed daily, as vessel storage techniques were limited. With the advent of larger vessels and improved methods of preserving, fish deliveries became less frequent, with landing records that at times, required months to compile.

Current resource management requires detailed and timely in-season catch information. In 1995, the Fraser River Sockeye Public Review Board recommended several changes to the B.C. catch reporting system in order to improve both the accuracy and timeliness of the data. The present catch reporting system for B.C. commercial salmon fisheries, implemented by DFO since 1998, includes several major programs: the fisherman logbook mail-in / phone-in program, the observer program and the sales slip program. The logbook and observer programs provide in-season catch information, while the sales slip program provides post-season information.

What Prompted This Study

This study was prompted by significant discrepancies observed between the in-season catch estimates (based on fisherman logbook records, observer records and other available data) and the post-season sales slip catch totals for the year 2000 sockeye fishing season. That is, the total in-season estimate of 967,000 sockeye pieces differed from the preliminary (Feb. 8, 2001) sales slip catch of 733,000 pieces by 234,000 (Table 1). In the past, discrepancies between the in-season estimates and post-season sales slip estimates also occurred, but generally not to this extent.

Concerns over the above discrepancies led to an audit of catch reporting for the year 2000 commercial sockeye fishery. The audit identified several major problems with the catch reporting system, and prompted DFO to conduct an in-depth investigation of the three major catch reporting programs (logbook, observer and sales slip). The analysis utilized the year 2000

commercial fishery data with a focus on sockeye salmon. This report presents the results of the audit and of the subsequent investigation.

Table 1. Preliminary comparison of in-season catch estimates and sales slip data for Fraser River sockeye, 2000 South Coast commercial fisheries (data as of Feb. 8, 2001). Area 23 Barkley Sound sockeye are excluded.

Gear	Licence Area	In-season Estimates * (commercial, research)	Sales Slip Data (commercial, test, research) **	Difference	% Diff. ***
Seine	B	325,000	207,000	118,000	36%
Gillnet	D	143,000	112,000	31,000	22%
Gillnet	E	417,000	344,000	73,000	18%
Troll	G,H	82,000	70,000	12,000	15%
TOTAL		967,000	733,000	234,000	24%

* In-season expanded estimates represent the best subjective estimates derived from fisherman logbooks, observer records, guardian hails and other information available in-season to fishery managers.

** Test catch component estimated at about 10% of the sales slip total, based on post-season analysis (see Table 7).

*** % Difference = % of (In-season estimates - Sales slip data)/ In-season estimates.

Scope of the Report

This report focuses on sockeye salmon and deals only with the commercial salmon catches on the South Coast of British Columbia. This region is managed by DFO and consists of five licence areas (seine Area B, gillnet Areas D and E, and troll Areas G and H) (Appendix 1). The report does not include recreational, First Nations or pilot sales fisheries, or illegal catches. The sales slip catch records (pieces) were calculated from total landed weights using the average fish weights obtained from the Mark Recovery Program.

2. CURRENT SALMON CATCH REPORTING SYSTEMS

DATA ACCURACY AND PRECISION

Calculation of total catch comprises two basic methods. The first is based on sales slips, and consists of adding up all landed catch data from all fishermen and reporting buyers to provide a total landed catch for an event. This method generates a nearly absolute account of total landed catch, provided that every fisherman submits complete records.

The second method uses the catch obtained from fishermen (via logbooks) or from trained observers. Both of these data sources provide a portion of the total catch. Each portion is then expanded by the total number of fishermen harvesting. The quality of this estimation method depends on:

- Size of sample as this affects the precision of the total estimate and
- Completeness of information as this affects the accuracy of the total estimate.

For example, the observer estimates of total catch have high accuracy because of complete and unbiased data collection for a given sample, but poor precision because of current small sample size. Conversely, the logbook estimates of total catch have high precision because of a large sample size, but may have poor accuracy because of potential biases related to fishermen's recollection.

In addition to the above calculations of total catch, there is a recent requirement to have all fish mortalities accounted for, especially where non-retention fisheries are prevalent. Accordingly, all fish encounters are recorded, and the total release mortality calculated in order to provide the overall mortality resulting from a fishing activity.

PROGRAM DESCRIPTION

Three major catch reporting programs are currently in use in British Columbia to monitor the commercial salmon fisheries: the logbook program, the observer program and the sales slip program. The sales slip program has been the longest in use and provides post-season catch data, while the more recent logbook and observer programs provide more timely and detailed in-season catch data. Table 2 compares the three major programs.

Table 2. Comparison of major catch reporting programs used in commercial salmon fisheries in B.C.

Program Feature	Sale Slip Program	Observer Program	Logbook Mail-in / Phone-in Program
Year implemented	1951	1998	1998
Fleet Coverage	Large	Small	Large
Data Availability	In/Post-season	In-season	In-season
Detail of Data	Moderate	Most Detailed	Detailed
Data Accuracy	May not be	Most Accurate	May not be
Data Completeness	May not be	Most complete *	May not be
Bio-sampling	No	Extensive	No
Responsible Party	Buyer/Fisher	DFO	Fishermen
Program Cost	Moderate	Highest	Moderate

* Catch data are complete for that portion of the fleet surveyed by observers.

Sales Slip Program

The sales slip program was initiated in the Pacific region in 1951, and historically has been the principal official means for capturing information on commercial fish landings. Sales slips are generally completed and submitted on behalf of commercial fishermen, by commercial buyers or offloaders at the time when fish are sold. However, fishermen are responsible for ensuring that their records are complete. Current licensing conditions make it mandatory for sales slips to be completed for all fish caught, even if the fish landed are used for bait, personal consumption, public or private sale, or disposed of otherwise.

In general, sales slips document the quantity (accurate weight and estimated numbers), value and species of the retained catch. Information about the sale includes: commercial buyer, purchase date, catching vessel, statistical area of catch, number of days fished, gear type, catch in numbers and weight by species and size grade, as well as the price per pound and value of the catch. The completed sales slips are forwarded to DFO regional headquarters for processing. Sales slips are a federal and provincial requirement for all commercial landings, and are to be completed and submitted to DFO within 7 days of landing the catch. Sales slip books are purchased or printed by buyers, offloaders and fishermen. See Appendix 5 and 6 for sales slip sample forms.

Logbook Program

The logbook program was initiated by DFO in 1998 in order to improve catch reporting and address the by-catch concerns, especially for coho salmon. The program consists of collecting detailed catch and release information from all individual fishermen in the South Coast commercial salmon fisheries. Fishermen are required to report by phone their logbook catch-summary on a weekly and sometimes daily basis, and to mail the completed logbooks to DFO by the end of the season. The phone-in data are used by fisheries managers to guide their in-season decisions. This program is mandatory to all commercial fishermen, and provides a large and cost-effective database encompassing the entire fleet. A portion of this program is funded by the fishermen through the purchase of logbooks. See Appendices 2, 3 and 4 for logbook sample forms.

Observer Program

Unlike the logbook program which involves the total fleet, the observer program samples only a portion of the salmon fleet. The observer program is the responsibility of DFO and was initiated in 1998 to operate in conjunction with the logbook program. Trained/DFO-certified observers are deployed on-board the commercial fishing vessels, with the aim of providing accurate and detailed catch information on a representative sample of the fleet. On-board observers monitor catch and release by species, gather biological samples (fish weight, length, scales, DNA, etc.) and conduct coho/chinook condition experiments. Data standards for catch reporting are upheld through a rigorous training course and certification examination, developed by DFO in conjunction with Malaspina University College. Currently, DFO funds the majority of the observer program, which is about four times the cost of the logbook program.

The combined information from the observer and the logbook programs, provides fisheries managers with timely and accurate catch and effort data. Managers utilize the daily information to track and minimize incidental catches while maintaining a harvest on target species.

Other Programs

Mark Recovery Program

The Salmon Catch Sampling and Mark Recovery Program (MRP) has been conducted annually by DFO since 1973, and consists of coast-wide sampling of B.C. commercial salmon fisheries. Trained samplers are positioned along the coast during the main fishing season, and dock-side samples are taken from all gear types and geographic areas, and from established fish processors and nomadic cash buyers. The major objective is to recover marked salmon for subsequent identification down to stock level and hatchery origin. The program also provides in-season and post-season data on numbers of fish sampled, numbers of marks recovered, and detailed records of fish lengths, weights, scales and otoliths, DNA bio-samples and fin-clip data. Fish weight information is used by DFO's Regional Data Unit to calculate the number of pieces from landed weights reported in sales slips.

Appendix 7 describes ground hail and dockside monitoring programs – the two supplementary tools to catch reporting.

3. DATA USES

Fisheries monitoring and catch reporting systems serve a variety of purposes including fisheries management, stock assessment, socio-economic analyses, and reporting to international agencies. Accurate information on the total catch (fish harvested, released and discarded) is required in the long-term to establish conservation targets for fishery resources, and in the

short-term to ensure that these targets are met. Catch information may be required on a real time basis, by detailed geographic area, by species and even by individual stock. Information on fishing effort in relation to catch is also important for harvest planning and management.

Fishery Management – In-season

Harvest planning and management of salmon stocks requires timely and accurate catch data of fish kept, released and discarded, as well as effort data. This information is essential to regulate fishery openings and closures, increase the chances of meeting escapement goals, and identify areas of high by-catch. Managers also utilize the detailed in-season data to monitor and control domestic allocation targets among different user groups (First Nations, recreational, commercial) and gear types (seine, gillnet, troll). Accurate catch records are also fundamental to meeting the reporting provisions of bi-lateral international treaties and the general reporting provisions of the United Nations.

Stock and Habitat Assessment

Fishery information collected from catch monitoring programs is essential for the assessment of salmon stocks. The collected biological data include salmon lengths and weights, DNA, otoliths, scales, coded-wire tags and fin-clips. When combined with catch statistics, these data provide valuable information on biological stock identification, marine distribution, run timing, age composition and stock abundance. Stock assessment information is also required for long-term planning (rebuilding and sustaining) of the resource, and for determining the overall impact of the fishery on the total environment (seabirds, marine mammals, etc.).

Taxes, Economics and Fisheries Stakeholders

Information on the value of the catch and on the extent and distribution of participation in fisheries, is essential to many groups – stakeholders, First Nations, Fisheries and Oceans Canada, and other government and non-government agencies that deal with socio-economic aspects of fisheries. The analyses include measurement of costs and benefits of the harvest, and assessment of impacts on employment and income due to changes in harvest. The information is also used to plan various government programs including workers' compensation, and other health and safety initiatives.

Regulations

Reporting requirements for participants in B.C. commercial salmon fisheries are governed by both federal and provincial statutes. The federal Fisheries Act, under Section 61, describes who may be responsible for providing the information and the relevant details. In the commercial salmon fishery, the responsible parties include any persons who purchase fish for the purpose of resale; and any owners, operators or managers of an enterprise that catches, cultures, processes or transports fish, as well as any agents or employees of those persons.

The required information includes:

- Details about any fish caught, cultured, processed, transported, sold or purchased;
- Time and place at which any fish was caught, landed or purchased;
- Vessels, gear types and methods used; and
- Any other matter relating to the proper management and control of fisheries, or to the conservation and protection of fish.

The responsible persons shall keep records in the manner prescribed by the regulations, lease or licence.

In addition to the above federal requirements, the B.C. provincial Fisheries Act requires the licensing of fish processors and buyers, as well as of fishermen selling directly to the public or retaining their catch for personal use. The reporting requirements for these licence holders are specified in the provincial Fisheries Act Regulations. These regulations also include details regarding the information to be recorded on sales slips, in support of the requirements of federal Fisheries Act. Fisheries and Oceans Canada uses commercial fishing licence conditions to specify the rules regarding the conduct of commercial fisheries, especially with respect to catch and effort reporting tools, and submission deadlines.

4. 2000 SALMON AUDIT

Each year, in-season estimates of salmon catch (based on logbook records, observer records and other available information) are replaced by post-season sales slip data. For the 2000 commercial fishing season, exceedingly large discrepancies were observed between the in-season estimates and the preliminary (Feb. 2001) post-season sales slip data involving Fraser sockeye. That is, for each Licence Area and gear type, the in-season estimates exceeded the sales slip totals by 15% to 36% (Table 1). In order to determine the exact nature of the discrepancy, DFO conducted an audit on the 2000 commercial sockeye fisheries (Areas B,D,E,G,H, Appendix 1).

AUDIT METHODOLOGY

The department assigned J.O. Thomas & Associates – an agency which conducts the Mark Recovery and Sales Slip Data Entry Programs – to compare catch records from logbook phone-ins / mail-ins and sales slips. That agency also reviewed the information obtained during the MRP sampling as these records indicated which vessels were known to be fishing. In the initial analysis, sockeye catch estimates based on phone-ins / mail-ins and sales slips were compared by Licence Area. The results showed that both the logbook mail-in records and the sales slip records were missing catch data. It was therefore decided to send form letters to those licence holders who had reported by phone a catch of more than 24 sockeye but had no sales slip records for that catch.

Table 3. Mailings and responses by Licence Area for 2000 salmon audit.

Licence Area	Original Mailing	Responses	New Sales Slips
B	15	10	12
C	2	0	0
D	83	44	45
E	90	56	56
G	65	50	5
H	73	50	8
Unknown	4	1	1
Total	332	211	127

The form letter, developed by DFO in cooperation with Conservation & Protection (C&P), requested fishermen to provide sales slips for a specific time period. J.O. Thomas & Associates supplied information on each salmon vessel, including catch records from each data source. This information was used to identify which licence holders would receive a letter. The form letters were sent to 332 salmon licence holders. Of the letters sent, 14 were unclaimed/ undeliverable, 66 yielded no response, 93 provided a total of 127 "new" sales slips, and the remainder generated no additional catch information (Table 3).

AUDIT RESULTS

The "new" sales slips generated a total of 51,073 additional salmon pieces. These included over 34,000 sockeye, the majority (64%) of which originated from the gillnet sector (Table 4).

Responses indicated that some fishermen did not read the letters sent by DFO, while some ignored, did not read, or did not understand their licence conditions. For example, some fishermen apparently were not aware that sale slips must show the total catch landed, irrespective of its subsequent use. Some fishermen were apparently confused by all the catch requirements specified in licence conditions; for example, they might confuse logbooks with sales slips, might not retain their own copies of catch records, or might not realize that sales slips are still required, in addition to logbooks.

Table 4. "New" sales slip catch information for 2000 salmon audit.

All Salmon			Sockeye Only		
Species	**Round Wt.**	**Pieces**	**Gear**	**Pieces**	**% of Total**
PINK	48,297	14,311	Gillnet	21,925	64%
CHUM	21,020	1,935	Seine	9,864	29%
SOCKEYE	204,542	34,317	Troll	2,015	6%
CHINOOK	5,802	510	unknown	514	1%
Total	279,661	51,073		34,318	100%

Many of the additional sale slips generated by the audit letters represented salmon catch that fishermen took home for personal use, or gave away, or sold directly to the public rather than to a commercial buyer. This was especially evident for the gillnet sector (Areas D and E) where 16% of the additional sockeye reported were not sold, compared to only 10% for the combined Licence Areas.

Almost 70% of the audited troll fishermen responded that their sales slips have been submitted previously. This misunderstanding stemmed from a discrepancy between fishing dates reported in logbooks and landing dates reported in sales slips. That is, while the logbooks and sales slips were compared by statistical week, the actual fishing may have occurred in one period and the landing made later on, so that a given logbook entry appeared to have no corresponding sales slip. It was felt, therefore, that any future audits of troll catches should include a more in-depth comparison of logbook and sales slip records prior to sending out any notification.

Missing sales slips came from 18 different fish buying companies, and the numbers of sales slips from each of these appeared in proportion to the volume of fish purchased. No obvious delinquents were identified, and the problem of missing sales slips appears to be widespread among fish buying companies. There was some difficulty in obtaining missing sales slips long after the fishery has ended. This is due to the volatile nature of the fish buying industry, as

companies may shut down at the end of fishing season or go out of business entirely. There were also concerns regarding weight to pieces conversion of sales slip data.

Table 5. Unexpanded Fraser sockeye catch by Licence Area and statistical week for three data sources (logbook phone-ins, mail-ins, sales slips), 2000 South Coast commercial fisheries (catch records as of May 17 and for sales slips also Dec. 31, 2001). Area 23 Barkley Sound sockeye are excluded.

UNEXPANDED SOCKEYE CATCH RECORDS *

Gear	Licence Area	Statistical Week	Logbook Phone-ins	Logbook Mail-ins	Sales Slips May 17	Sales Slips Dec. 31
Seine	B	081	--	--	3,052	3,052
		082	239,611	161,285	235,332	235,794
		083	467	1,120	467	467
		084	9,092	10,279	8,743	9,135
		091	31	22	280	280
Sub-Total			249,201	172,706	247,874	248,728
Gillnet	D	064	--	--	144	144
		075	--	--	286	445
		081	52,966	30,678	55,824	52,180
		082	45,980	27,409	38,999	42,805
		083	23,116	15,043	22,579	21,973
		084	237	190	521	637
		091	137	87	765	954
		092	--	--	131	131
		093	--	--	--	422
		094	--	--	1	1
		102	--	--	1	1
Sub-Total			122,436	73,407	119,251	119,692
Gillnet	E	075	145,062	104,513	161,760	165,993
		081	--	--	1,794	1,961
		082	191,813	131,401	192,149	203,895
		083	--	--	2,041	2,148
		084	8,833	5,402	6,000	8,023
		091	--	--	441	441
		093				8
		103				173
		121				262
Sub-Total			345,708	241,316	364,184	382,903
Troll	G,H	064				761
		071				19
		073				0
		074				0
		075	135	113	26	29
		081	33,803	19,443	7,387	7,405
		082	30,278	18,241	42,163	40,674
		083	16,016	8,243	25,481	22,680
		084	727	544	4,361	4,393
		091	--	--	78	66
		092	--	--	908	868
Sub-Total			80,959	46,584	80,405	76,895
TOTAL			**798,304**	**534,013**	**811,714**	**828,218**

* Logbook phone-ins and mail-ins include commercial catch only; sales slips include commercial catch and research catch (research catch is negligible, see Table 7).

As part of the 2000 audit, the unexpanded Fraser sockeye catches from phone-ins, mail-ins and sales slips, were broken down by statistical week (Table 5, preliminary data as of May 17, 2001). Note that these weekly catches formed the basis for Table 1. The main objective of constructing Table 5 was to help detect any obvious discrepancies between the different catch estimates (recognizing that these are unexpanded values), in order to identify and correct the specific problems. However, the weekly catch data suggested that the discrepancies were more wide-ranging and complicated than was originally thought, requiring further in-depth investigation.

5. COMPARISON OF DIFFERENT CATCH REPORTING SYSTEMS

The in-depth investigation conducted by DFO following the 2000 audit, involved primarily the comparison of in-season, logbook and observer catch estimates (all expanded to cover the entire fleet) with unexpanded sales slip catch data (as of Dec 31, 2001). As mentioned previously, the in-season estimates were not independent values but rather represented the best subjective estimates derived from a variety of data sources (fisherman logbooks, observer records, guardian hails and all other information available in-season to fishery managers). The logbook phone-ins represented a coverage of 85% for the five combined Licence Areas (range 77-98% for each Area) and the observer program represented a coverage of 6% (range 3-11% for individual Areas) (Fisheries and Oceans Canada 2001). The compliance for the sales slip program in 2000 was undetermined.

The investigation proceeded from general to specific, with catch data first examined by gear type and Licence Area, then by statistical week, and lastly by individual vessel. In this report, sockeye data include catches from all South Coast fishing areas, except for Tables 1 and 5 which include only Fraser sockeye (Area 23 sockeye catches excluded). Also, Tables 1 and 5 are based on
preliminary catch data (as of Feb. and May 2001); all other tables (and part of Table 5) are based on refreshed data (as of Dec. 31, 2001).

INVESTIGATION RESULTS

In-season catch versus sales slip catch by gear type and Licence Area

As mentioned above, the significant difference between the expanded in-season estimates and the unexpanded sales slip totals was first observed during the preliminary examination of the year 2000 Fraser sockeye catches by gear type and Licence Area (data as of Feb. 2001). For total Areas, the sales slip catch was lower than the in-season catch estimate by 234,000 pieces or 24% (range by Area of 15% to 36%) (Table 1). The actual discrepancy was even higher because the sales slips included test catches while the in-season estimates did not.

After intensive attempts to gather the missing sales slips through the 2000 audit program, and adding these records into DFO database, the results still showed a significant shortfall in the total sales slip catch compared to the in-season estimates. For total Areas, the shortfall was 154,931 pieces or 15% (range by Area of 8% to 23%) (Table 6, data as of Dec. 2001). Note that the preliminary and final in-season estimates (Tables 1 and 6, respectively) differed somewhat due to later minor adjustments, such as the addition of very late phone-in data.

Sales slip catch components

We examined the sales slip catch components in order to identify which values were being compared. The components included commercial catch (90%), test catch (10%) and research catch (0.4%) (Table 7). We did not include the test catch in our investigation, except in Table 1.

Table 6. Final comparison of in-season catch estimates and sales slip data for all South Coast sockeye, 2000 commercial fisheries (data as of Dec. 31, 2001).

		FINAL DATA			
Gear	Licence Area	In-season Estimates * (commercial, research)	Sales Slip Data (commercial, research)	Difference	%Diff. **
Seine	B	327,945	253,974	73,971	23%
Gillnet	D	166,708	132,825	33,883	20%
Gillnet	E	416,556	382,903	33,653	8%
Troll	G	28,905	22,546	6,359	22%
Troll	H	63,697	56,632	7,065	11%
TOTAL		1,003,811	848,880	154,931	15%

* In-season expanded estimates represent the best subjective estimates derived from fisherman logbooks, observer records, guardian hails and all other information available in-season to fishery managers.

** % Difference = % of (In-season estimates - Sales slip data) / In-season estimates.

Table 7. Sales slip catch components for sockeye by fishery type (research, test, commercial), 2000 South Coast commercial fisheries (data as of Dec. 31, 2001).

		SALES SLIP CATCH COMPONENTS BY FISHERY TYPE			
Gear	Licence Area	Research *	Test	Commercial	Total
Seine	B	3,052	32,091	250,922	286,065
Gillnet	D	273	5,851	132,552	138,676
Gillnet	E	-	56,206	382,903	439,110
Troll	G	-	702	22,546	23,248
Troll	H	-	-	56,632	56,632
TOTAL		3,325	94,850	845,555	943,730
% of total		0%	10%	90%	100%

* Includes Selective Fisheries.

In-season, observer, logbook and sales slip catch by gear type and Licence Area

We next examined whether a particular fishing sector was responsible for the discrepancies observed between the observer, logbook and sales slip records. Catch data (as of Dec. 31, 2001) were broken down by gear type and Licence Area, and the three expanded estimates (in-season, observer and logbook) were compared with the unexpanded sales slip catch (Figure 1, Table 8).

For each Area, the sales slips generally showed the lowest catch, while the expanded catch estimates (in-season, observer and logbook phone-in) generally showed a good agreement with each other, except for gillnet Area E where the observer estimate was the highest. The difference between the highest and lowest catch estimates by Area ranged from 13% to 25% (Table 9).

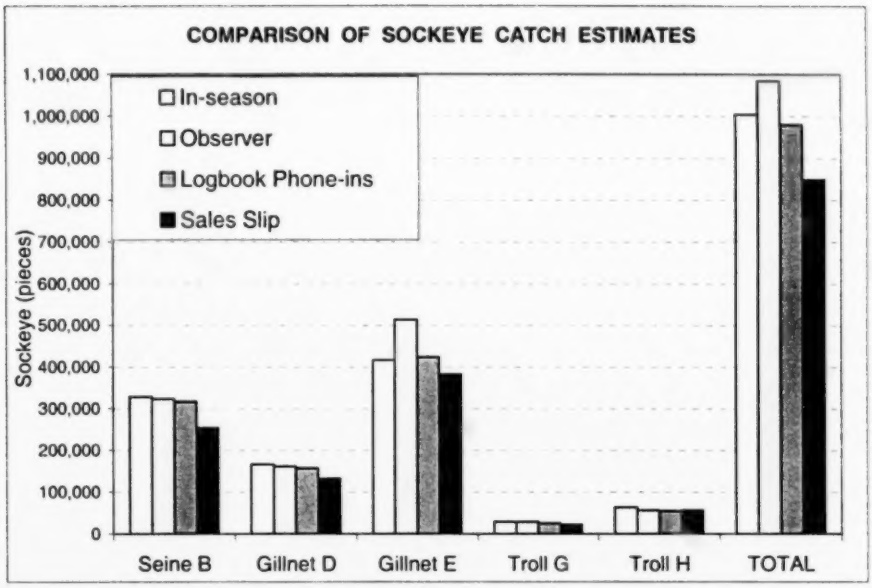


Figure 1. Comparison of expanded sockeye catch estimates (in-season, observer, logbook) and unexpanded sales slip estimates by Licence Area, 2000 South Coast commercial fisheries (data as of Dec. 31, 2001).

Table 8. Comparison of expanded sockeye catch estimates (in-season, observer and logbook phone-in) and unexpanded sockeye sales slip catch by Licence Area, 2000 South Coast commercial fisheries (data as of Dec. 31, 2001).

	Licence	Expanded Catch Estimates +			Unexpanded Catch
Gear	Area	In-season ++	Observer	Logbook Phone-ins	Sales Slip
Seine	B	327,945 *	323,719 *	317,187 *	253,974
Gillnet	D	166,708	161,564	157,173	132,825
Gillnet	E	416,556	513,488	424,555	382,903
Troll	G	28,905 **	29,073 **	25,399 **	22,546
Troll	H	63,697 ***	56,810 ***	55,318 ***	56,632
TOTAL		1,003,811	1,084,654	979,632	848,880

+ In-season, observer and logbook phone-in catch estimates expanded by gear count (i.e., known information by gear expanded to provide total catch for entire fleet).

++ Expanded in-season catch estimates represent the best subjective estimates derived from fisherman logbooks, observer records, guardian hails and all other information available in-season to fishery managers.

* Each expanded value for Licence Area B (seines) includes in-season estimate (13,980 pieces) for Area 16 which was not covered by observers.

** Each expanded value for Licence Area G (troll) includes in-season estimate (636 pieces) for Area 23 for days not covered by observers.

*** Each expanded value for Licence Area H (troll) includes in-season estimate (151pieces) for combined Areas 12, 13 and 16 for days not covered by observers.

Table 9. Difference between highest and lowest catch estimates for 2000 salmon audit.

Gear	Area	Highest Est.	Lowest Est.	Difference	% Diff. *
Seine	B	In-season	Sales Slips	73,971	23%
Gillnet	D	In-season	Sales Slips	33,883	20%
Gillnet	E	Observer	Sales Slips	130,585	25%
Troll	G	Observer	Sales Slips	6,527	22%
Troll	H	In-season	Logbook	8,379	13%
Total		Observer	Sales Slips	235,774	22%

* % Difference = (Highest – Lowest) / Highest (Table 8 data).

Catch by statistical week

We also examined the unexpanded phone-in and mail-in catch data, and sales slip data by Area and statistical week, in order to determine which Area/week stratum was the most problematic in terms of data discrepancy. Table 5 shows that for a given statistical week for each of seine Area B and gillnet Areas D and E, there was a good agreement between the logbook phone-in catch and sales slip catch (data as of Dec. 31, 2001). By comparison, for troll Areas G/H, the weekly logbook phone-in and sales slip catches appeared to be out of synch with each other, suggesting a delay in sales slip catch reporting. This observation confirms the audit-letter responses from fishermen (see Audit results).

Vessel reporting compliance by gear type and Licence Area

The completeness of logbook and sales slip records relies heavily on the reporting compliance. Compliance is generally less than 100% as not all fishermen provide logbook data or submit sales slips. It was felt that the most likely maximum compliance is represented by the number of logbooks issued, rather than the number of licences issued. This is because some licenced vessels may not participate in a fishery and hence may not have a logbook. Indeed, the total number of vessel licences issued was substantially higher than the total number of logbooks issued (1,243 versus 957) (Figure 2, Table 10).

The number of logbooks issued also may not represent the total number of participating fishermen as some fishermen may not buy a logbook. However, this issue was considered to be minor as the incidence of fishermen using someone else's logbook or trying to use last year's logbook, was low. Note that the above vessel reporting compliance provides only general data trends due to the occurrence of dual logbooks (two logbooks per vessel) and dual licences (two licences per vessel) (see Table 10, footnotes).

For all Licence Areas, the mail-in compliance (i.e., number of vessels that reported one or more times) was lower than the phone-in and sales slip compliance (606 vessels versus 909 and 954, respectively, for total Areas) (Figure 2, Table 10). These compliance numbers are below the total logbooks issued (957), indicating that not all participating fishermen provided catch data. The low reporting compliance for mail-ins can be related directly to the low unexpanded mail-in catch; the higher reporting compliance for sales slips can be related to the higher sales slip catch (Table 11).

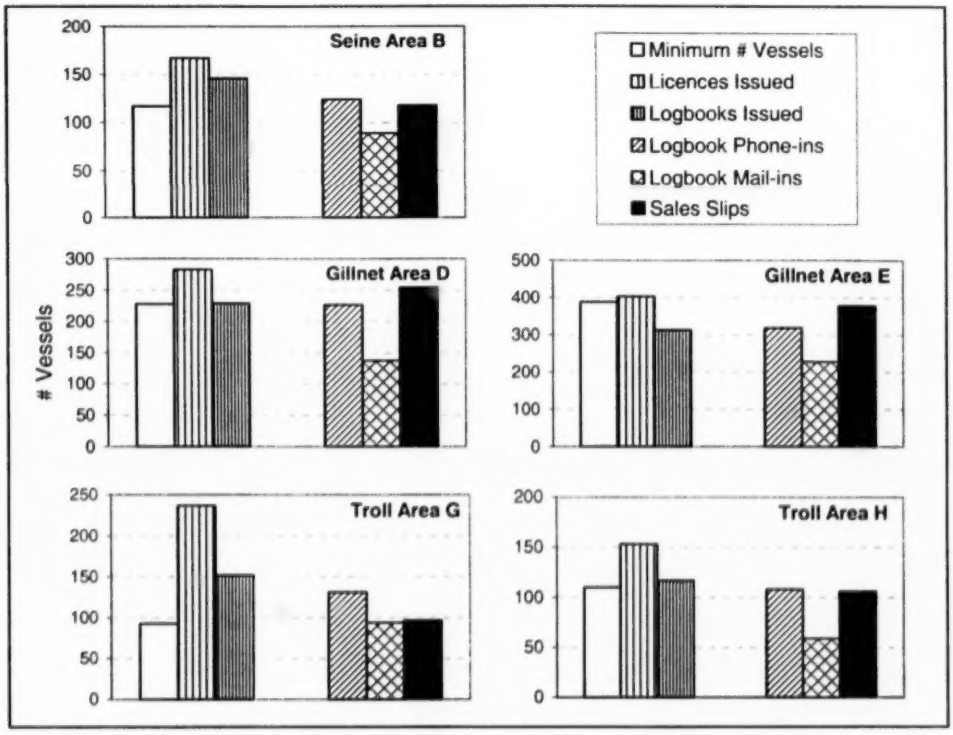


Figure 2. Vessel reporting compliance with respect to logbook phone-ins / mail-ins and sales slips for sockeye catches, 2000 South Coast commercial fisheries (data as of Dec. 31, 2001).

Table 10. Vessel reporting compliance with respect to logbook phone-ins, logbook mail-ins and sales slips for sockeye catches, 2000 South Coast commercial fisheries (data as of Dec. 31, 2001).

VESSEL REPORTING COMPLIANCE

Gear	Licence Area	Min. # Vessels Participating *	#Vessel Licences Issued	# Logbooks Issued **	# Vessels with +			
					Vessel Licences***	Logbook Phone-ins	Logbook Mail-ins	Sales Slips
Seine	B	117	167	146	176	124	89	118
Gillnet	D	228	283	229	293	227	137	255
Gillnet	E	388	403	313	416	319	227	378
Troll	G	93	237	152	242	131	94	97
Troll	H	110	153	117	155	108	59	106
TOTAL		936	1,243	957	1,282	909	606	954

+ Number of vessels reporting one or more times.

* Minimum number of vessels participating in the commercial fishery, based on largest gear count per licence area for any one day during overflights.

** Some vessels were issued more than one logbook. In other cases, a single logbook was issued to a given vessel with a dual licence so that catches from both Licence Areas were recorded in one logbook; these logbooks were counted twice (23 logbooks shared Areas D and E; 8 logbooks shared Areas G and H).

*** Number of vessels with a commercial fishing licence for all or part of fishing season (i.e., includes licence transfers among vessels within a fishing period). Note: 30 gillnet vessels had dual licences (i.e., were licenced to operate in both Areas D and E), also 12 troll vessels had dual licences (i.e., were licenced to operate in both Areas G and H).

Table 11. Relationship between unexpanded catch and number of vessels reporting, 2000 South Coast commercial fisheries.

Total Areas	Logbook Mail-ins	Logbook Phone-ins	Sales Slips
# Vessels Reporting (Table 10) *	606	909	954
Unexpanded Catch (Table 5)	534,013	798,304	811,714

* Number of vessels reporting one or more times.

Catch for vessels with observer, logbook and sales slip records

We next investigated individual vessels that had catch data for each reporting program (observer, logbook and sales slip). These data were obtained from 28 vessels representing 62 vessel-days. Only unexpanded catch data were used for this comparison (Figure 3, Table 12).

For each Area, the sales slip catch was the lowest (except for the small troll catch in Area G where all catch values were similar). Also for total Areas, the sales slip catch was the lowest (15,595), the phone-in catch was higher (16,710), and the observer and mail-in catches were the highest (17,460 and 17,611, respectively).

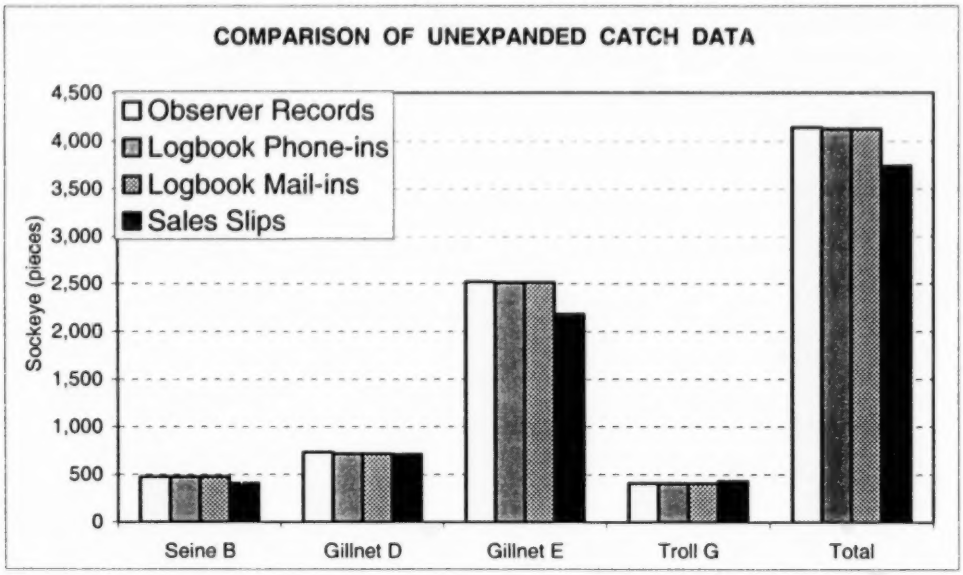


Figure 3. Comparison of unexpanded sockeye catches for those vessels and vessels-days with all records (observer, logbook phone-ins / mail-ins and sales slips), 2000 South Coast commercial fisheries (data as of Dec. 31, 2001).

Table 12. Comparison of unexpanded sockeye catches for those vessels and vessels-days with all records (observer, logbook phone-ins / mail-ins and sales slips), 2000 South Coast commercial fisheries (data as of Dec. 31, 2001).

COMPARISON OF UNEXPANDED CATCH DATA

Gear	Licence Area	# with all Records		Observer Records	Logbook Phone-ins	Logbook Mail-ins	Sales Slips
		Vessels	Vessel-Days				
Seine	B	5	8	7,895	7,523	7,895	7,008
Gillnet	D	9	17	1,622	1,632	1,673	1,561
Gillnet	E	10	19	7,534	7,146	7,634	6,594
Troll	G	4	18	409	409	409	431
Troll	H	0	0	-	-	-	-
TOTAL		28	62	17,460	16,710	17,611	15,595

Catch by individual vessel

Given that combining the catch by Area in Figure 3 and Table 12, may have masked the actual data trends for individual vessels, we examined the above unexpanded catch data more closely by looking at individual vessels and record dates (a record date represents a fishing date for observer and logbook records, and a landing date for sales slips). Note that these data represent selected records where the sales slip catch could be clearly attributed to the matching observer and logbook catch data (Appendix 8).

Appendix 8 shows that for seine Area B and gillnet Area E, the majority of individual vessels showed lower sales slip catches compared to observer and logbook catches; this is in agreement with Table 12. For gillnet Area D, the individual vessels showed identical catches or a somewhat lower sales slip catch, again in agreement with Table 12. For troll Area G, the individual vessels generally showed identical observer and logbook catches, and a slightly higher sales slip catch, again in agreement with Table 12. The above indicates that the data trends observed in Figure 3 and Table 12 were not masked by pooling the catch data for individual vessels.

Comparison of the logbook catch and the more accurate observer catch by vessel and gear type, showed that troll vessels had the lowest discrepancy between the two values. This indicates that troll logbook records are more accurate than seine or gillnet logbook records (Appendix 8). This is likely related to the low daily troll catches, compared to the larger seine and gillnet catches. Another observation was that the majority of seine and gillnet vessels generally showed only a small discrepancy (<100 pieces) between the daily observer and logbook catches. This suggests that any major inaccuracies in logbook records may be attributed to a small portion of the fleet.

We also suspected other logbook problems that were not observed in the available data (Appendix 8), but which may become apparent in a larger database. For example, we expected the logbook catch to be less accurate (when compared to observer catch) for seine gear than for gillnet or troll gear, especially when a large catch was made. We also expected that some seine fishermen may tend to overestimate the catch of the more valued target species in their logbooks; this has been supported in previous analyses by comparing initial logbook estimates with landed catch estimates. However, we saw no evidence of this bias, possibly because the available seine data in Appendix 8 contained relatively modest daily catches. Another concern

was that species composition in seine catch estimates may not be accurate. Even if the overall catch numbers are accurate, an inaccurate estimate in species composition will affect the accuracy of the estimated catch for each species.

Finally, an inspection of these and other catch records for individual vessels, showed that for seine and gillnet vessels, the fishing dates – as reported in observer and logbook mail-in/phone-in records, were in good synchrony with the landing dates – as reported in sales slips (generally within 1 day of each other). By comparison for troll vessels, the landing dates generally lagged behind the fishing dates by a week or more.

Catch discrepancies for different salmon species

We also investigated catch discrepancies for different salmon species by comparing the expanded observer and logbook catch estimates available for 1999 and 2000 South Coast commercial salmon fisheries (Fisheries and Oceans Canada 2000, 2001). A total of 60 observer / logbook data pairs were available for comparison for both years and all species; those data pairs with few fish (sum of observer and logbook estimates less than 30 fish), were excluded. Note that the logbook estimates were derived from both phone-in (1999) and mail-in (2000) records of those 60.

Of the 60 data pairs, 41 had a higher observer estimate than logbook estimate, while 31 data pairs showed an absolute difference of 20% or more between the two estimates (Appendix 9). Table 13 shows the difference between the total observer and logbook estimates by species.

Table 13. Difference between the overall expanded observer and logbook catch estimates by species for 1999 and 2000 South Coast commercial salmon fisheries.*

Species	Expanded Estimates		Difference	% Difference
	Observer	Logbook	(Obs-Log)	(Obs-Log) / Obs
Sockeye – retained	1,155,593	1,049,851	105,742	9%
Pink – retained	1,973,324	1,398,901	574,423	29%
Chum – retained	407,334	395,909	11,425	3%
Chinook – retained	93,981	85,904	8,077	9%
Chinook – released	52,238	29,976	22,262	43%
Coho – released	26,774	21,760	5,014	19%
Stealhead – ret'd / rel'd	2,006	982	1,024	51%
Atlantic – retained	8,059	7,296	763	9%

* Data from DFO 2000, 2001 (Appendix 10).

For each of the seven salmon species above, the total observer estimate was higher than the total logbook estimate, which agrees with our study results for sockeye. The discrepancy between the two estimates tended to be lower (3-9%) for the more abundant species (sockeye and chum but not pinks), and considerably higher (19-51%) for the less abundant species (chinook, coho, steelhead. The Atlantic salmon showed a low (9%) discrepancy between the two catch estimates, despite its low numbers, probably because of the distinct and hence easily recognizable appearance of this species. The large discrepancy for pink salmon observed above, may be attributed to the small observer sample size, combined with a highly variable pink catch for individual vessels.

SUMMARY OF INVESTIGATION RESULTS

1. Of the three catch estimates (observer, logbook and sales slip), the observer values were generally the highest and the sales slip values the lowest. That is, sales slips routinely underestimated the sockeye catch.

2. Vessel reporting compliance was lower for logbook mail-ins compared to phone-ins or sales slip submissions.

3. Troll vessels (but not seine or gillnet vessels) showed a marked delay in sales slip catch reporting compared to logbook reporting.

4. All species of salmon may show significant discrepancies between the expanded observer and the expanded logbook catch estimates. These discrepancies tend to be more pronounced for the less abundant non-target species.

6. DISCUSSION

PROBLEMS WITH DIFFERENT SALMON CATCH REPORTING SYSTEMS

The major finding of our investigation was that sales slips generally gave the lowest catch, while the observer estimates gave the highest catch. In 1996, a multidisciplinary DFO group examined the catch reporting system for B.C. commercial salmon fisheries, and identified a number of problems (Fisheries and Oceans Canada 1997). Those problems and additional issues identified here, are discussed below. Table 14 summarizes the degree of impact of different sources of error on each reporting program. Clearly, the sales slip program shows the most problems, and the observer program the fewest.

Table 14. Impact of different sources of error on major catch reporting programs used in commercial salmon fisheries (impact rated as **X** = major, x = minor, - nil).

	Degree of Impact per Program		
Error Source	**Observer**	**Logbook**	**Sales Slips**
1. Non-compliance	-	**X**	**X**
2. Behaviour (confusion over reporting process)	-	**X**	**X**
3. Report delays	-	x	**X**
4. Misreporting	-	**X**	X
5. Logistics problems	**X**	x	X
6. Data verification	-	**X**	**X**
7. Data entry and interpretation problems by DFO	x	x	X
8. Discrepancy due to weight to pieces conversion	-	-	X
9. Time lag between fishing & landing dates	-	-	X
10. Non-retention issue (releases and discards)	-	x	**X**
11. Biological samples	-	**X**	**X**
12. Program cost	**X**	x	X
13. Lack of enforcement	-	**X**	**X**

Sales Slip Program Issues

- Non-compliance and misreporting: Sales slip program may not reflect the total landed catch due to unreported catch and non-compliance. These problems are attributed to the profusion of individual commercial buyers and increasing numbers of fishermen marketing their products

directly to consumers. The varying degrees of failure to submit sales slips arise because the system requires considerable co-operation from fishermen and buyers. As well, there are tax and other benefit-related incentives (e.g. Employment Insurance) to avoid reporting or to report inaccurately.

- Non-retention: Sales slip program does not provide information on releases or discards.
- Biological samples: Sales slip program does not provide biological fish samples.
- Timeliness and detail of data: This program cannot provide timely and detailed catch information essential for the current intensively managed salmon fisheries. Also, there may be a time lag between fishing and landing dates, especially for troll fisheries. As well, the requirement to submit sales slips to DFO within 7 days of landing the catch, is often not met and not enforced.
- Data verification: It is difficult to monitor and police catch reporting in sales slips, and data verification is a major problem.
- Weight to pieces conversion: There are some concerns over the conversion of sales slip landed weights into pieces.
- Impact on other programs: The Mark Recovery Program which currently relies heavily on the sales slip data, has become increasingly compromised by lack of information due to less frequent commercial fishery openings and increasingly large unreported catches.

Based on the above, the sales slip program which historically has represented the official catch estimates for B.C. commercial salmon fisheries, may not provide the best or most accurate catch totals.

Logbook Program Issues

The present logbook system, although capable of providing detailed and timely information on catch, fishing location and timing, is not completely accurate. Note that the presence of on-board observers likely influences fishermen's catch reporting, resulting in more accurate logbook records than if observers were absent. Consequently, the problems with logbook records may be more severe for that portion of the fleet unmonitored by observers.

- Non-compliance and misreporting: The logbook program suffers from many of the same deficiencies as the sales slip program in terms of failure to submit, failure to submit an accurate account and misreporting. As with the sale slip system, the logbook program relies on the active co-operation of fishermen, and their willingness and ability to provide complete and accurate information. As well, the logbook program has similar financial incentives to under-report or misreport the total harvest.
- Biological samples: The logbook system does not provide information on average fish weights or biological fish samples.
- Data verification: As with sales slips, it is difficult to monitor and police catch reporting in logbooks, and data verification is a major problem.
- Seine catch estimation: Often the volume of seine catch is overestimated as the fish are not counted individually.

Observer Program Issues

Currently, the on-board observer program is the responsibility of DFO and is considered to provide more accurate catch data than the fisherman logbook program. The shortcomings of the observer program are as follows:

- High program cost: Especially the cost of hiring and deploying the observers.
- Low fleet coverage: Less than desirable sample size due to partial observer coverage, which leads to reduced precision of observer catch estimates.
- Logistics problems: Difficulty in maintaining observers on-board many fishing vessels due to small vessel size and limited on-board accommodation.
- Non-random observer sample: Reluctance on the part of some fishermen to accept on-board observers results in a non-random boarding access and hence a biased observer sample.
- Catch bias: The presence of on-board observers may affect the behaviour of fishermen, resulting in catch biases (Karp and McElderry 1999, Kennelly 1999, Salveson et al. 1992).

DATA REQUIREMENTS

Data Accuracy and Precision

Incomplete and misreported catch information compromises DFO's ability to manage fisheries, especially where different limitations and regulations are required to conserve stocks at risks. As mentioned above, the quality of catch estimates depends on:

- Completeness of information as this affects the accuracy of the total estimate and
- Size of sample as this affects the precision of the total estimate.

The issues that affect the accuracy and precision of salmon catch information are listed below.

Accuracy issues

Estimated catch versus absolute catch

- The observer and logbook catch estimates are derived from catch data expanded by effort. The "absolute" sales slip catch is a cumulative total catch and does not include an estimate of non-reported catch. Both the estimated and absolute catch reporting methods have shortcomings that may lead to significant discrepancies between the different catch values.

Non-compliance

- Sales slip compliance for actual receipt of sales slips is approximately 70%, and the problem of missing sales slips appears to be widespread among the fish buying companies (DFO draft Memorandum, Feb. 2001).
- Logbook compliance varies from year to year, from gear to gear, and from area to area, and ranges from 50% to 95% (DFO draft Memorandum, Feb. 2001).

- The variable reporting compliance affecting both logbooks and sales slips, occurs despite existing standards for data delivery, such as sales slip reporting requirement of 7 days after completion of transaction.

- Sales slip non-compliance may result from fishermen's neglect of licence conditions. That is, sales slips may not be filled out for take-home catch, or for salmon given away or sold directly to the public rather than to a commercial buyer, or stored frozen for future sales.

- Non-compliance may be related to lack of understanding by fisherman that logbooks and sales slips are two independent and equally important reporting requirements.

- Non-compliance may be related to language and literacy problems.

- Reduced compliance may occur at the start of fishing season, as fishermen may be less familiar with new programs initially. This may affect any self-reporting system.

- Compliance regarding take-home catch may vary at the start and end of the fishing season. Greater compliance may be expected at the start as some fishermen may need funds and will sell most of their catch early on; poorer take home compliance may be expected at the end of the season, as fish prices may fall due to surplus on the market, making it less profitable to deliver the catch to buyers.

- Logbook non-compliance may result if a fisherman is unable to phone-in the catch due to remote fishing location.

- Observer non-compliance will result if a fisherman fails to accept an observer on-board the fishing vessel.

Misreporting

This refers to incorrect information regarding fishing area, gear, species and number of fish.

- Seine catches are reported in round numbers (especially when a large seine catch is made) compared to gillnet and troll catches.

- Possible overestimation in logbooks of the more valued species such as sockeye, compared to pinks.

- Approximate or inaccurate piece count in sales slips.

Biased reporting

- Intentional under-reporting of by-catch (e.g., steelhead, coho) due to possible management actions such as fishery closure; also unintentional under-reporting of by-catch due to low incidence of these species.

- Possible under-reporting of target catch due to potential fishery closures or other enforcement actions.

Incomplete reporting

- Incomplete reporting of by-catch of fish species, as well as sea birds and marine mammals caught in salmon fisheries.

- Suspected non-reporting by some fishermen.

Data collection and entry errors

Errors made during data entry, and problems with data interpretation may compromise the usefulness of catch information, and confound data management.

- Handwritten logbook and sales slip records may be illegible and difficult to read.
- Data-entry errors may not be identified even after DFO staff have reviewed the data.
- Multiple licences and/or multiple logbooks per vessel may complicate data auditing and interpretation. For example, a given vessel may carry at the same time two fishing licences (e.g., for Areas G and H), with catch for both Areas recorded in the same logbook. Also, as a result of licence transfer among vessels, a given licence may be assigned to more than one vessel.

Enforcement issues affecting non-compliance

Currently, the enforcement of catch reporting regulations is lacking.

- Licence conditions such as data submission deadlines, are rarely enforced.
- Regulatory requirements for sales slip catch reporting are rarely enforced.
- Enforcement of acceptance of observers on-board fishing vessels receives a low priority.
- Identification of non-compliance can be time-consuming, and hence difficult to address.

Precision issues

Small sample size

Small sample size affects the precision of observer records and is due to:

- Cost of observer program,
- Logistics related to observer accommodation and deployment, and
- Reluctance of fishermen to accept independent observers.

Accuracy and precision issues

Total fishing effort

- Information on the total fishing effort may be inaccurate and incomplete. If not all fishermen report their catch, then an estimate of those who have not reported, must be included. This issue affects both the precision and accuracy of the reported catch information, and ultimately affects the expanded catch estimates based on observer and logbook records.

Data Standards and Completeness

Currently, few formal standards are in place in salmon fisheries for specifying which data are to be collected for each species and fishery, and how they are to be reported. A Catch Monitoring Workshop held by DFO in November 2001, has led to a draft set of catch reporting standards for commercial salmon fisheries. Table 15 lists these data standards, and evaluates the current catch reporting systems for their ability to address the standards.

Table 15. Preliminary data standards and the ability of present catch monitoring tools to address them (**X** addresses fully, x addresses partially, - not at all).

Preliminary Data Standards	Sales slips	Log-books	Observer program*	On-ground hails	Dock-side*	Post-season price survey
1. Total retained catch #s	x	**X**	**X**	x	x	x
2. Total released catch #s	-	x		x	-	-
3. Total effort	x	x	x	x	x	-
4. Mean weight – retained catch	x	-	**X**	-	x	-
5. Bio-samples – retained catch	-	-	**X**	-	x	-
6. Bio-samples – released catch	-	-	**X**	-	-	-
7. Total annual discards **	-	x	**X**	x	-	-
8. Total annual value	x	-	-	-	-	x
9. Coverage	**X**	**X**	x	x	x	**X**

* Currently, partial dockside monitoring/sampling and observer programs are used only periodically.

** Discards include sea birds and marine mammals.

Currently there is no single program that fully addresses all data standards because of the issues presented here. However, the observer program has the greatest potential to fully address most of the requirements.

Data Management

Timeliness of data delivery

- A portion of the fleet fails to meet the logbook deadlines for phoning or mailing-in the data. This confounds both the in-season fishery management and the post-season interpretation of catch records.

- Many sales slips are not submitted by the 7-day reporting deadline, affecting the usefulness of sales slips even as a post-season tool.

Time-lag between fishing and landing dates

- Time-lag between logbook fishing dates and sales slip landing dates may be a week or longer. As a result, the logbook and sales slip record dates may be incompatible, especially for troll fisheries. This is because troll openings are longer and the travelling distances to port farther, resulting in longer delays between actual fishing and landing. The above time-lag is observed less frequently for seine and gillnet fisheries due to shorter (1- or 2-day) openings and hence more rapid fish delivery to buyers. Awareness of this synchronization problem is necessary when comparing the different catch records by statistical week.

Weight to pieces conversion

Most sales slip records show accurate estimates of landed weight as these values are used to calculate the payment to fishermen. By comparison, sales slip records are considered to have less accurate total pieces landed, especially when large volumes are delivered and only approximate total pieces recorded (rounding off effect). For this reason, DFO recalculates the sales slip record of total pieces landed.

Average fish weight may be derived for a given sampling block (i.e., statistical area and week, gear type and species) from two different data sources – sales slip records and MRP biological

samples. The average weights reported in sales slips may not be accurate; for example, a buyer may use an arbitrary average weight to convert the total landed weight to pieces, or the sample size may be very small (<10 pieces, Table 16). By comparison, the MRP average weight which is generally based on a large sample size, is considered to be relatively accurate and is used by DFO to convert the total landed weight to pieces. This latter number overrides any piece count reported in sales slips.

We compared the average sockeye weights based on MRP and sales slip data (Figure 4, Table 16). Note that the average sales slip weights were based on highly variable numbers of sales slips (1-673). Marked differences were observed between the average weights based on MRP and sales slip data. Of the available 18 data pairs (MRP and sales slip), only half (9) were within 0.25 lb of each other, while 4 data pairs differed by 0.5 lb up to 2.3 lb (Table 17).

Generally, any discrepancies between the MRP and sales slip average fish weights are of little concern because the more accurate MRP weights are used for the weight to pieces conversion. The problem arises when the MRP data are themselves in error or missing.

MRP weight data are in error: For example, for seine Area B, statistical week 083, a large discrepancy was observed in average sockeye weights based on MRP and sales slip data (4.6 lb and 5.7 lb, respectively, Table 16). This MRP value was also significantly lower than the MRP values for two adjoining weeks (6.3 lb and 6.2 lb), strongly suggesting an MRP error for week 083. If left undetected, this error may result in potentially serious under-estimation of the total pieces landed.

MRP weight data are missing: In this case, the use of potentially inaccurate average weights from sales slips, may result in equally inaccurate estimation of total pieces landed.

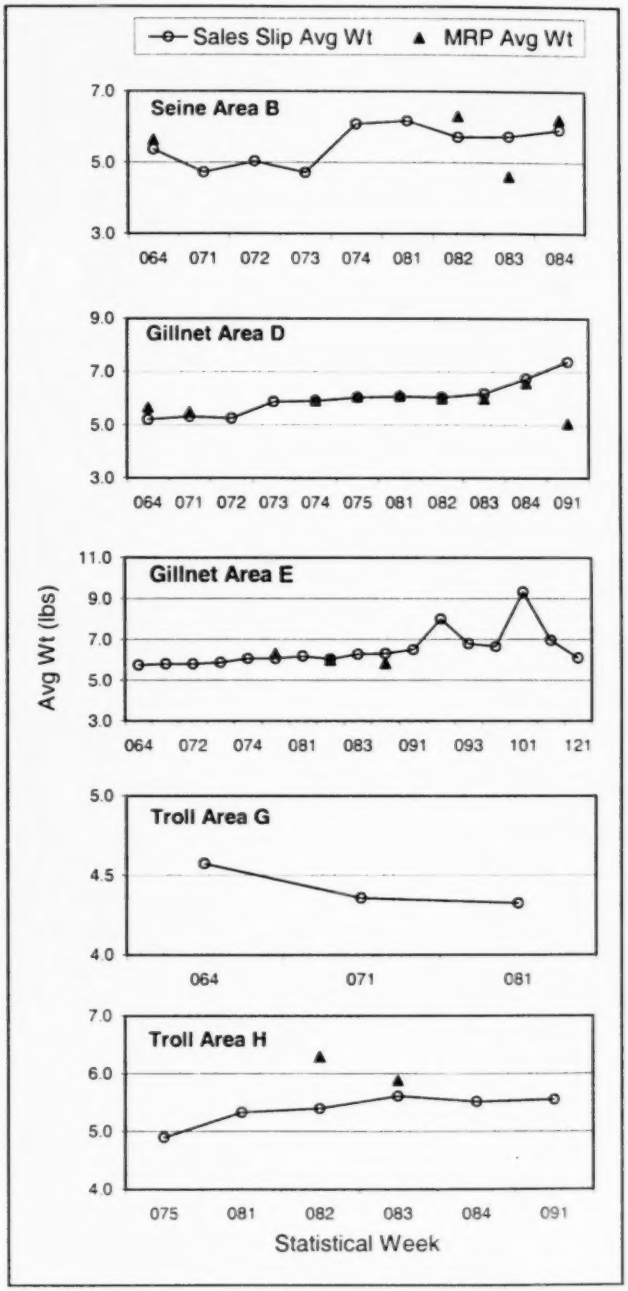


Figure 4. Comparison of average round weights of sockeye salmon based on sales slip data and MRP data, 2000 South Coast commercial fisheries.

Table 16. Comparison of average round weights of sockeye salmon based on sales slip data and on MRP in-season biological samples, 2000 South Coast commercial fisheries.

COMPARISON OF AVERAGE SOCKEYE WEIGHTS

Gear	Licence Area	Statistical Week	Sales Slip Data			MRP Data	
			Av. Wt. (lb)	(n) fish *	(n) slips **	Av. Wt. (lb)	(n) fish *
Seine	B	64	5.37	1,668	1	5.64	100
		071	4.73	514	1		
		072	5.03	3,044	1		
		073	4.71	1,688	1		
		074	6.09	2,515	1		
		081	6.17	9,362	5		
		082	5.72	63,603	30	6.30	700
		083	5.74	599	29	4.61	179
		084	5.93	8,786	35	6.21	107
Gillnet	D	064	5.21	6,554	61	5.65	100
		071	5.31	4,392	74	5.48	495
		072	5.25	842	4		
		073	5.88	415	11		
		074	5.90	892	15	5.91	350
		075	6.03	6,505	30	6.06	379
		081	6.06	97,504	468	6.10	7,877
		082	6.04	86,102	389	6.00	8,256
		083	6.17	42,664	424	5.99	5,016
		084	6.73	580	14	6.57	70
		091	7.37	2,184	4	5.04	170
Gillnet	E	064	5.75	4,236	21		
		071	5.80	15,698	49		
		072	5.80	11,624	42		
		073	5.87	19,967	56		
		074	6.07	22,936	52		
		075	6.08	222,251	657	6.32	357
		081	6.19	15,875	55		
		082	6.05	260,414	673	6.00	3,372
		083	6.28	4,767	41		
		084	6.31	13,613	322	5.83	12
		091	6.50	807	17		
		092	8.00	3	3		
		093	6.79	34	11		
		094	6.67	9	6		
		101	9.33	9	6		
		103	6.97	173	1		
		121	6.10	262	1		
Troll	G	064	4.57	75	6		
		071	4.36	28	2		
		081	4.32	979	13		
Troll	H	075	4.89	38	4		
		081	5.33	14,575	72		
		082	5.40	47,735	215	6.30	12,706
		083	5.61	34,384	284	5.88	2,117
		084	5.52	4,709	49		
		091	5.55	116	2		

* (n) fish = number of fish pieces used in the average weight calculation.

** (n) slips = number of sales slips used to determine the average weight.

Table 17. Difference in average sockeye weights based on sales slip data and MRP data.

Absolute Difference (Sales slip value – MRP value)	Number of Data Pairs
0.00 - 0.25 lb	9
0.26 - 0.50 lb	5
0.51 - 1.00 lb	2
Over 1.00 lb	2
Total	18

* Based on Table 16 and Appendix 11.

AUDIT REQUIREMENTS

There is a clear need for a consistent system to verify and audit independently the validity and completeness of the catch information provided. The current auditing provisions within the commercial salmon fishery are weak, with no formal audit programs in place. The specific concerns are as follows:

- There is an ongoing potential within the logbook and sales slip programs to avoid reporting or to misreport the harvest, due to financial or other incentives. These programs are particularly vulnerable as they rely on the full co-operation and commitment of the harvesters. This problem would apply to any self-reporting system.
- Cross-checking of sales slip and logbook data for consistency is sometimes used as an audit on the system. However, there is no assurance that either of these data are accurate since the records are not independently verifiable.
- The observer records and dockside monitoring records are viewed as complete and reliable, and could be used to audit the logbook records. However, this information is generally used as an alternative to the sales slip and logbook information, rather than a cross-check on those two systems. As well, the observer program covers only a small portion of the fleet and the cost of full observer coverage would be prohibitive.
- Finally, there is no independent audit of the data provided by monitors and observers.

OTHER ISSUES

Program Cost and Duplication of Catch Reporting

Overlapping in the provincial and federal requirements regarding fishing licencing and regulations causes confusion regarding reporting responsibility.

- Table 15 shows considerable duplication of reporting effort among the different systems, particularly regarding the total retained catch.
- Also, program cost differs greatly among the different systems, with the observer program being the costliest, compared to the logbook and sales slip programs.
- Cost-sharing responsibilities also differ among the programs. For example, DFO pays fully for the observer program in some salmon fisheries, while the logbook program is funded by the licence holders and the Department.

The above indicates a need for a rigorous analysis of effort duplication, and ways to streamline data collection in salmon fisheries to improve data quality and reduce program costs. Examination of program objectives needs to be reviewed to ensure future applicability. Cost sharing has been adjusted and will need to be discussed with users. In addition, mechanisms for cost reorganization need to be secured to ensure maximum benefit to program users.

7. RECOMMENDATIONS

Recommendation 1. Determine the minimum DFO catch reporting requirements.

- Use the minimum catch reporting requirements to guide the development of improved catch reporting regulations (Table 15 gives the preliminary catch reporting standards).

Basic requirements such as percent fleet coverage and precision for each species and fishery, are still being investigated. Note that most non-salmon fishermen already meet much higher data reporting standards and support them fully.

Recommendation 2. Discontinue the present sales slip program.

- Discontinue the present sales slip program for the commercial salmon fisheries (similar to recommendation made by Bijsterveld, L. 2001).

The present sales slip system is inadequate for the current monitoring and reporting needs in salmon fisheries. Problems include incomplete and inaccurate catch data, and insufficient timeliness of delivery. Even the information on landed value may be suspect as sales slips often do not include significant post-season bonus payments. In recent years, more reliable estimates of prices and landed value have been derived from post-season surveys of fish buyers. Note also that while sales slips are an accepted source of income information by various government agencies (Canada Customs and Revenue Agency, Human Resources and Development Canada, provincial Workers' Compensations Board, etc.), they are not a required document by these agencies, but rather records customarily used as a source of income information.

The resources used in processing sales slip information would be better diverted to improve other elements of the catch monitoring and reporting system. The final decision must be made with utmost care, as it will have major ramifications on both domestic and international decision-making regarding the salmon resource.

Recommendation 3. Continue the present observer program.

- Continue the present observer program for audit and bio-sampling purposes.
- Require those vessels with limited on-board space to receive observers for part of the day.
- Implement full funding of the observer program by fishermen, regarding routine data collection and delivery.

The present mandatory observer program captures all but one (total landed value) of the information requirements accurately and completely for a portion of the fleet. As such, the observer program has all the attributes of a central data source on catch information, and can be used to audit fisherman logbook data. Note that a mandatory (100%) on-board observer program would be difficult to implement due to the high cost of the program.

Recommendation 4. Revise and improve the logbook program and data delivery.

- Upgrade the present logbook system to ensure enhanced delivery to DFO of complete information on the key data requirements for the commercial salmon fishery (total retained catch, total releases and total annual discards, see Table 15 above).
- Implement strong audit measures to (a) encourage compliance with logbook reporting requirements and (b) identify any significant biases in the information provided.

An enhanced, more effective logbook and logbook data management system would fully address some of the key data requirements, and reduce and even eliminate the need for an on-ground hail system. Fishermen will be requested to provide only basic information needs; additional information will be collected by other means. A stable annual requirement would help reduce the problems with incomplete and inaccurate information associated with human-behavioral issues.

Recommendation 5. Provide clear direction to fishermen regarding catch reporting requirements.

- Provide more clarification and clearer direction to fishermen regarding catch reporting requirements.

Recent changes in the catch reporting system may be a source of confusion to some fishermen. For example, the relatively low compliance rate for logbook mail-ins observed in our study, may reflect in part the confusion indicated by fishermen during the audit communications (see above).

Recommendation 6. Develop a formal auditing system.

- Investigate the possibility of integrating observer monitoring, dockside monitoring and Mark Recovery programs to provide both the auditing and bio-sampling requirements. A well-designed, integrated program of observers, monitors and MRP staff could provide both the audit and the sampling function in a cost-effective way. However, the degree of coverage required for sampling and for audit purposes may vary, depending on area and fishery. This recommendation is similar to that developed in the DFO Catch Monitoring Workshop (Nov. 2001).

The current logbook system has unavoidable incentives to misreport salmon harvest. In order to ensure the integrity of logbook information, an active and visible audit system is required. An effectively designed audit system can identify the relative bias in the information provided and facilitate the necessary adjustments. It can also improve compliance by facilitating the application of penalties where catch reporting rules and regulations have been contravened. As well, it can provide bio-sampling data (mean fish weights, samples of kept and released fish, etc.) essential to meet data requirements in the commercial salmon fisheries.

Recommendation 7. Formally integrate the logbook and licence programs.

- Monitor logbook compliance and require fishermen to submit logbook information prior to licence renewal. That is, if fishermen are negligent in submitting the required logbook information, DFO will require additional time to investigate the issues, thereby possibly delaying licence renewal.

Currently, salmon licences and logbooks are obtained separately, and are not dependent on the logbook-compliance history of fishermen.

Recommendation 8. Establish data matrix tables with average fish weights.

- Use historical records of fish weights to develop a series of baseline data matrix tables with average fish weight by species, gear type, fishing area and cycle year (e.g., 4-year cycle for sockeye).
- Use these matrix tables to periodically audit the MRP weight data to check for errors or discrepancies.
- Also use the matrix tables for those cases where the average weights are missing altogether from MRP records.

Currently, the Department relies on MRP records to provide accurate data on average fish weights in order to convert sales slip landed weights to pieces. However, where MRP average weights are missing or incorrect, significant under- or over-estimation of total pieces may result. The recommended matrix tables should fully address this issue.

Recommendation 9. Improve enforcement of regulations.

- Enforce rigorously the regulatory requirements for catch reporting.
- Enforce the acceptance of observers on-board fishing vessels through fishery closures and other management actions.
- Increase DFO's policing resources in order to enforce effectively the rules for catch reporting.

Improved enforcement of regulations is vital for the conservation and protection of salmon resource.

Recommendation 10. Set up a user-governing system of catch monitoring.

- Require fishermen to provide additional monitoring resources where basic catch information and standards are not being met.

DFO should have in place a base-level observer program for auditing and biological sampling. However, where basic catch information and standards are not being met in a fishery (as determined by comparing logbook records with observer or dockside records), then fishermen will be required to provide additional monitoring.

Recommendation 11. Streamline user costs and partnerships.

Program costs: The cost of any catch monitoring program almost always increases with increased benefit. For example, an increase in precision and accuracy of the observer program is cost related. The crucial question is what are the minimal results acceptable (i.e., benefits) and at what costs (DFO draft document on Catch Monitoring Strategy Plan).

- Several pilot initiatives are proposed to reduce program costs; for example, pooling of recreational and commercial observers, combining monitor / observer training, and utilizing other related programs such as charter patrol and/or test fisheries.
- Several catch monitoring strategies are currently in place to help streamline these programs. In some areas, a pilot program has been initiated where creel surveyors will act as on-board observers.
- At-sea observer training for surveyors is currently in progress, and observer deployment methods are being reviewed to explore cost effectiveness.

- Where possible, the administration of recreational and commercial logbook programs will be combined to streamline distribution and data processing.
- Observer training is required to insure the quality of information. These costs will decline starting in 2001, as part of the costs will be transferred to the students in the form of tuition fees.

Partnerships: In order for catch reporting systems to succeed, a cooperative approach is required between the key players (federal and provincial governments, harvesters and buyers).

- The review process should include the Province as it directly responsible for licensing of commercial salmon buyers, brokers, vendors, and processors, as well as the reporting of B.C. seafood industry production and wholesale value.
- A joint federal/provincial review of their respective regulations in needed in order to remove program duplication.
- Harvesters should have well defined roles and responsibilities. This group should be responsible and accountable for providing accurate and complete information on their harvest, and for the costs associated with the collection and delivery of this information to the Department.
- The final responsibility for a number of catch reporting and monitoring matters must continue to rest with the Department. These responsibilities include: establishing the catch reporting standards; defining and implementing the audit process; enforcing the regulations pertaining to catch reporting; managing, storing and analyzing the data provided; and ensuring public accessibility to catch data.

Recommendation 12. Review and revise existing post-season landed price survey.

- Review the existing program and revise as necessary to ensure that all components of the commercial salmon industry and types of salmon marketing are represented.

The present survey of landed price focuses largely on commercial buyers. This means that the landed value to fishermen may be significantly underestimated due to an increasing trend towards self-marketing by fishermen to the general public.

ACKNOWLEDGEMENTS

The authors would like to acknowledge Bruce Cahusac and Jim Thomas of J.O. Thomas & Associates for their work preparing the initial comparison of landing records for this study and for providing information for audit letters. Fishery Officer Alistair Thomson was instrumental in developing and distributing the form letter for commercial salmon fishermen as well as lending his authority as an Officer to the study. Marc Hamer, provided valuable background regarding the Mark Recovery Program methodology. Carmen McConnell and Lee Kearey provided logbook data and fishery information, Bruce Patten was supportive in accessing updated logbook data and Wendy Don provided and interpretated licencing data. Report printing is provided by Beverly Agar of the Pacific Biological Station.

REFERENCES

Bijsterveld, L. 2001. Fish Slip Retirement Review. In-house document prepared for Catch Data Working Group. 9p.

Fisheries and Oceans Canada. 1997. Salmon Catch Reporting Recommendations. Memorandum prepared by Salmon Catch Working Group (Dec. 12, 1997). 29 p.

Fisheries and Oceans Canada. 2000. Summary Report: Observer and Logbook Monitoring Programs for South Coast Commercial Salmon Fisheries, 1999. Prep. by Fishery Management Group, B.C. 24 p.

Fisheries and Oceans Canada. 2001. 2000 Summary Report: South Coast Salmon Catch Monitoring Programs Observer, Logbook and First Nations Catch Reports. Prep. by Fishery Management Group, B.C. 24 p.

Fisheries and Oceans Canada. 2002. Pacific Region Fishery Monitoring and Reporting Framework. January 2002. 19 p.

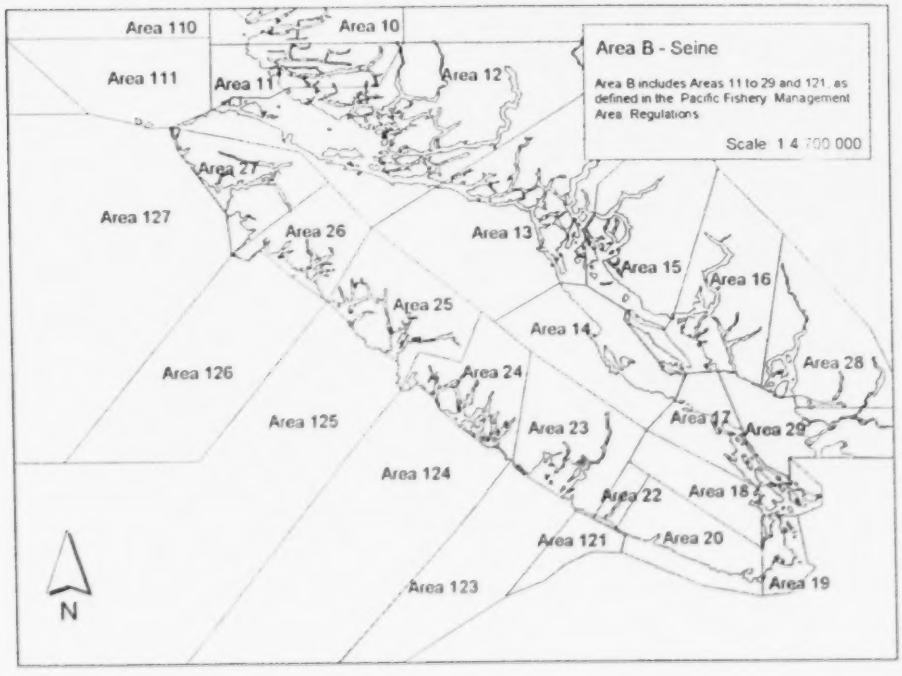
Karp, W.A. and H. McElderry. 1999. Catch monitoring by fisheries observers in the United States and Canada. Proceedings of the FAO symposium of the International Conference on Integrated Fisheries Monitoring. pp. 261-284.

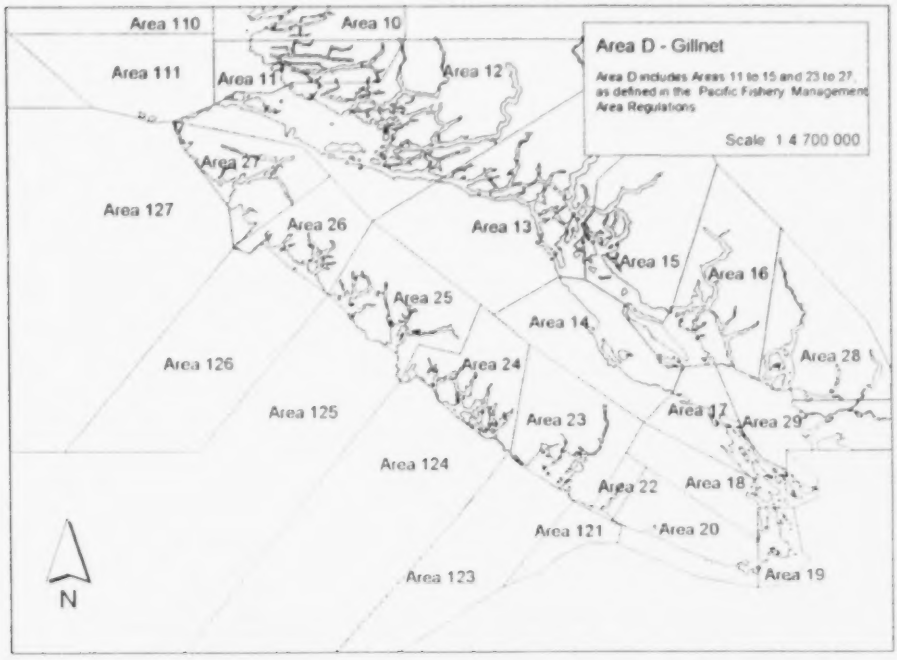
Kennelly, S.J. 1999. The role of fisheries monitoring programmes in identifying and reducing problematic bycatches. Proceedings of the FAO symposium of the International Conference on Integrated Fisheries Monitoring. pp. 75-81.

Salveson, S., B.M. Leaman, L.-L. Low and J.C. Rice. 1992. Report of the Halibut Bycatch Work Group. International Pacific Halibut Commission, Tech. Rep. No. 25.

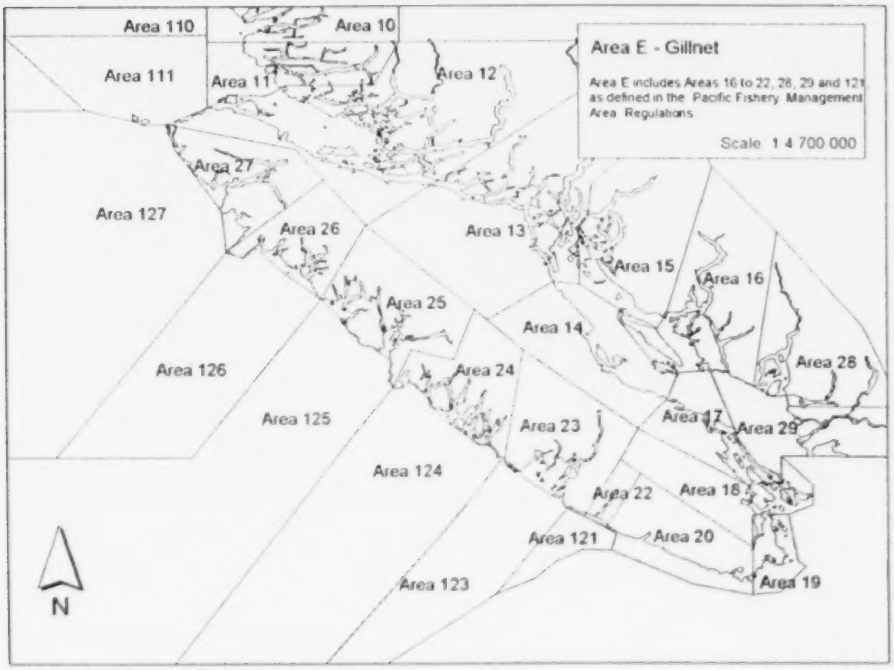
APPENDICES

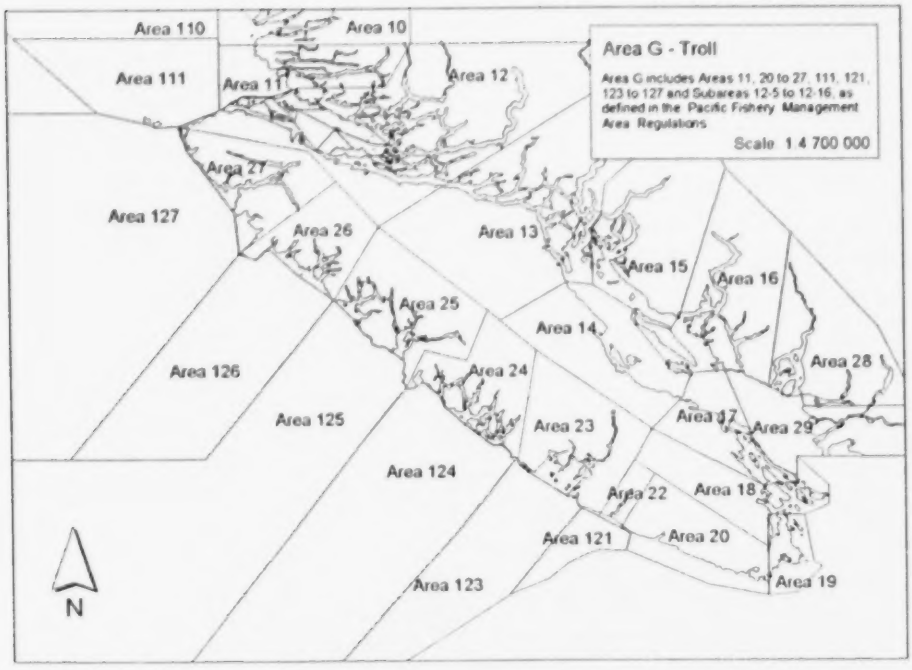
Appendix 1. Commercial salmon fishing Licence Areas for South Coast of British Columbia.



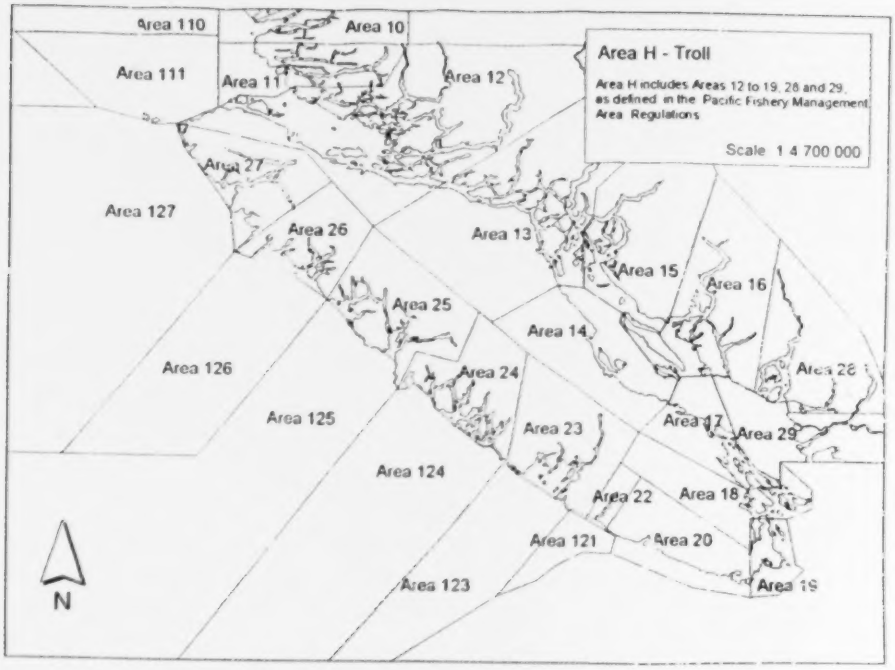


Appendix 1. (continued)





Appendix 1. (continued)



Appendix 2. Salmon Gillnet Logbook Form.

Logbook I.D. # G **SALMON GILLNET LOGBOOK** **Report Catch to: 1(888) 387-0007** Record all catch in pieces **Page #**

Vessel Name _____ VRN (CFV#) _____ Skipper _____

*Net Type (circle one) A or M or C Net Length _____ fathoms Weedline Depth _____ Hang Ratio _____ Mesh Size _____ # of Mesh _____

Date Fished	Statistical Area	Subarea(s)	# of Sets	Hours Fished	**Kept or Released	Sockeye	Coho	Pink	Chum	Chinook	Steelhead	Atlantics	Birds	*** Other Species
Day / Month					Kept									
					Rel									
					Kept									
					Rel									

Comments

Confirmation#:

Did you have an OBSERVER? Y or N (circle one)

Date Fished	Statistical Area	Subarea(s)	# of Sets	Hours Fished	**Kept or Released	Sockeye	Coho	Pink	Chum	Chinook	Steelhead	Atlantics	Birds	*** Other Species
Day / Month					Kept									
					Rel									
					Kept									
					Rel									

Comments

Confirmation#:

Did you have an OBSERVER? Y or N (circle one)

Date Fished	Statistical Area	Subarea(s)	# of Sets	Hours Fished	**Kept or Released	Sockeye	Coho	Pink	Chum	Chinook	Steelhead	Atlantics	Birds	*** Other Species
Day / Month					Kept									
					Rel									
					Kept									
					Rel									

Comments

Confirmation#:

Did you have an OBSERVER? Y or N (circle one)

Draft

*Net Types: A = Alaska Twist M = Multi Strand C= Combination

Note: **Kept are species retained on board, **released** are species returned to the ocean

***Other Species: M=Mackerel L=Lingcod H=Halibut D=Dogfish R=Rockfish S=Sturgeon Marine Mammals are to be identified by species

2002

Appendix 3. Salmon Seine Logbook Form.

Logbook I.D. # S **SALMON SEINE LOGBOOK** **Page #**

Report Catch to: 1(888) 387-0007 Record all catch in pieces

Vessel Name _____ VRN (CFV#) _____ Skipper _____

Date Fished	Statistical Area	Subarea(s)	# of Sets	Hours Fished	*Kept or Released	Sockeye	Coho	Pink	Chum	Chinook	Steelh'd	Atlantics	Birds	*Other Species
Day: Month:					Kept								X	
					Rel.									
					Kept								X	
					Rel.									

Comments

C

Did v OBSERVE (circle one)

Day: Month:					Kep								X	
					Rel									

Comments

Confirmation#

Did you have an OBSERVER? **Y or N** (circle one)

Delivery Information				Pieces or lbs or kg (circle one)						
Dates Fished Day: Month:	Delivery Date Day: Month:	#of Days Fished	Sockeye	Coho	Pink	Chum	Chinook	(Other)	Was this delivery pooled with that of another vessel?	
									Received from ☐ Delivered to ☐	Vessel Name
Business Delivered To					Port				Slip#	
									Received from ☐ Delivered to ☐	Vessel Name
Business Delivered To					Port				Slip#	

*Other Species: M=Mackerel L=Lingcod H=Halibut D=Dogfish R=Rockfish Marine Mammals are to be identified by species 2002

Note: Kept are species retained on board **released** are species returned to the ocean

Draft

Appendix 4. Salmon Troll Logbook Form.

Logbook I.D. # T **SALMON TROLL** **Report Catch to: 1-(888) 387- 0007** Record all catch in pieces Page #

Vessel Name _____ VRN (CFV#) _____ Skipper _____

Date Fished	Statistical Area	Zone ☐ (Subarea) ☐	Hours Fished	*Kept or Released	Sockeye	Coho	Pink	Chum	Chinook	**Grilse	Atlantic	***Groundfish	****Other Species
Day				Kept									
				Rel									
Month				Kept									
				Rel									

Comments

Confirmation#

Did you have an OBSERVER? Y or N (circle one)

Date Fished	Statistical Area	Zone ☐ (Subarea) ☐	Hours Fished	*Kept or Released	Sockeye	Coho	Pink	Chum	Ch	Gril	***Groundfish	****Other Species
Day				Kept								
				Rel								
Month				Kept								
				Rel								

Comments

Confirmation#

Did you have an OBSERVER? Y or N (circle one)

Date Fished	Statist Are	ne ☐ rea) ☐	Kep Refe	ockeye	Coho	Pink	Chum	Chinook	**Grilse	Atlantic	***Groundfish	****Other Species
Day			Kept									
			Rel									
Month			Kept									
			Rel									

Comments

Confirmation#

Did you have an OBSERVER? Y or N (circle one)

Draft

*Kept are species retained on board, released are species returned to the ocean

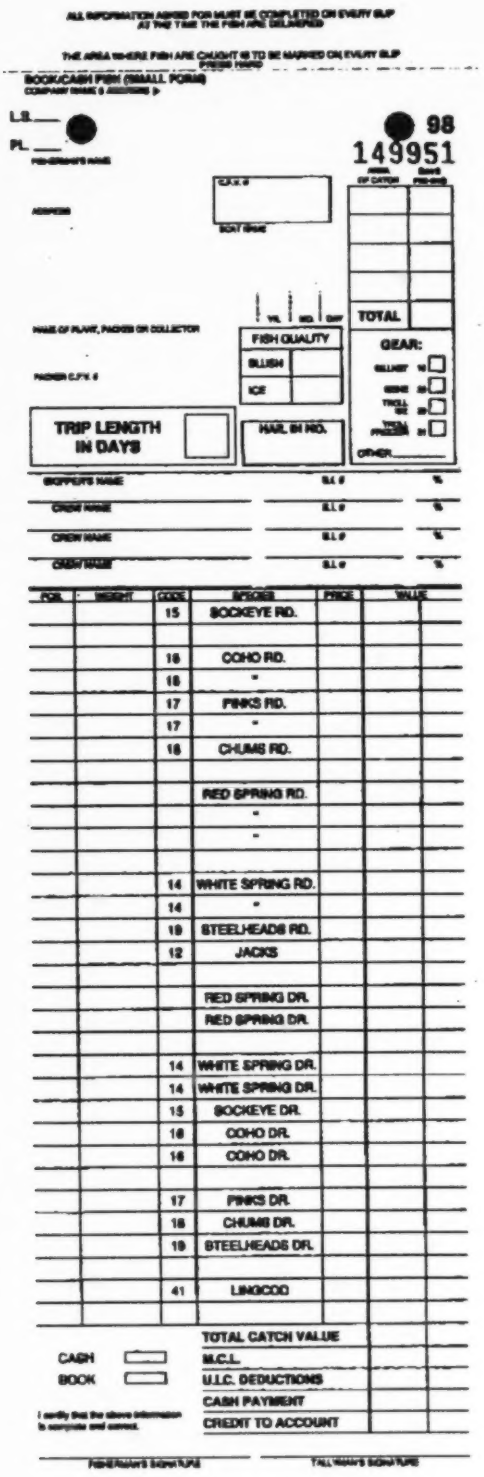
**Grilse are juvenile salmon under 30cm

***Groundfish: L= Lingcod, H=Halibut, D=Dogfish, Rockfish are to be identified by species (see inside front cover)

****Other Species: M= Mackerel S= Steelhead B=Bird

2002

Appendix 5. Cash Small Sales Slip.



ALL INFORMATION ASKED FOR MUST BE COMPLETED ON EVERY SLIP AT THE TIME THE FISH ARE DELIVERED

THE AREA WHERE FISH ARE CAUGHT IS TO BE MARKED ON EVERY SLIP

BOOK/CASH FISH (SMALL FORM)

L.S. ____ PL. ____

98

149951

TOTAL

FISH QUALITY

BLUSH

ICE

GEAR:

OTHER

TRIP LENGTH IN DAYS

HAUL IN NO.

POR.	WEIGHT	CODE	SPECIES	PRICE	VALUE	
		15	SOCKEYE RD.			
		16	COHO RD.			
		16	"			
		17	PINKS RD.			
		17	"			
		18	CHUMS RD.			
			RED SPRING RD.			
			"			
			"			
		14	WHITE SPRING RD.			
		14	"			
		19	STEELHEADS RD.			
		12	JACKS			
			RED SPRING DR.			
			RED SPRING DR.			
		14	WHITE SPRING DR.			
		14	WHITE SPRING DR.			
		15	SOCKEYE DR.			
		16	COHO DR.			
		16	COHO DR.			
		17	PINKS DR.			
		18	CHUMS DR.			
		19	STEELHEADS DR.			
		41	LINGCOD			
			TOTAL CATCH VALUE			
			M.C.L.			
			U.I.C. DEDUCTIONS			
			CASH PAYMENT			
			CREDIT TO ACCOUNT			

CASH ☐

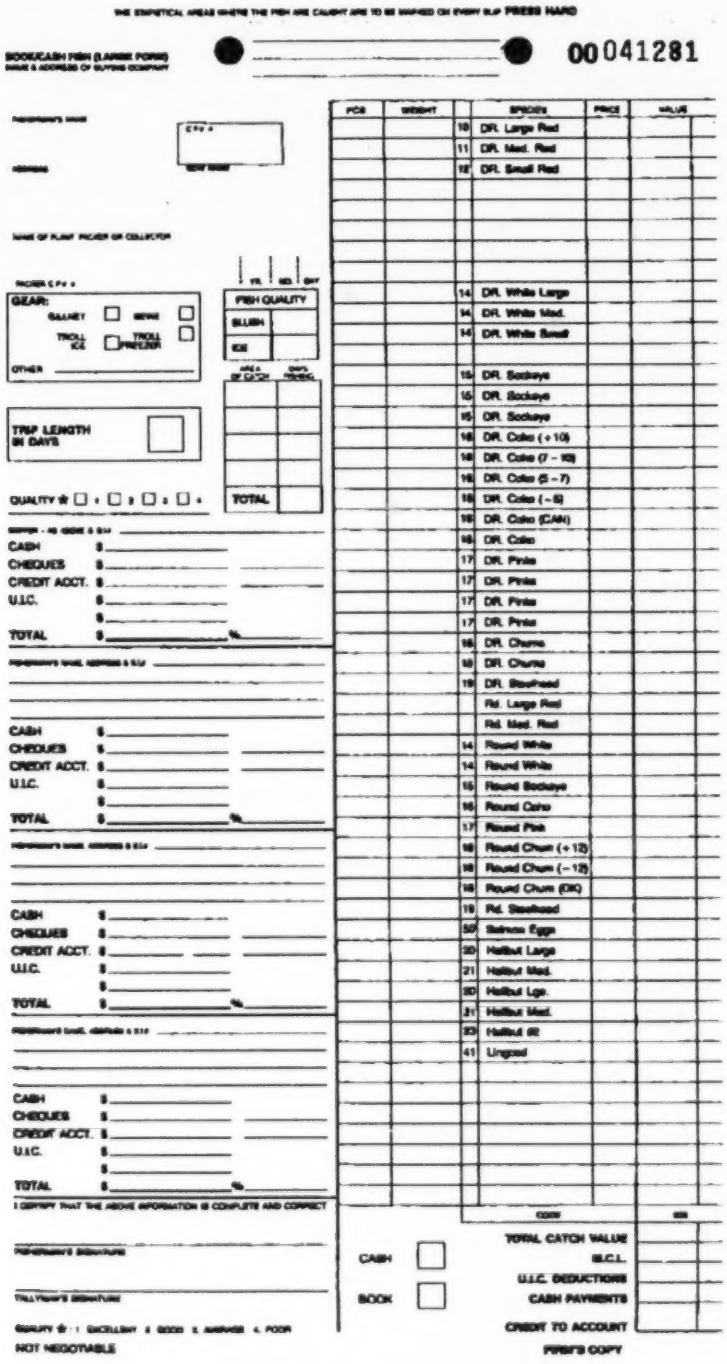
BOOK ☐

I certify that the above information is complete and correct.

FISHERMAN'S SIGNATURE

TALLYMAN'S SIGNATURE

Appendix 6. Cash Large Sales Slip.



Appendix 7. Supplementary monitoring tools.

On-ground hail program

The on-grounds hail program requires fishery officers or chartered patrolmen to request verbal catch estimates of salmon catch, releases and discards, from actively fishing vessels

Issues

- As with sales slips and logbooks, a hail system relies on the active co-operation of fishermen.
- Further, it relies on their ability to accurately estimate their harvest at a point in time.
- There is also some incentive for inaccurate reporting (e.g., if a possibility exists that the fishery may be halted due to presence of species or stocks of concern).
- On-ground hail system relies on the ability of fishery officers or chartered patrolmen to obtain a full census of the operating fleet, or at least to identify accurately the proportion of the fleet that has been surveyed.
- On-ground hail system can represent unnecessary duplication of effort where there is a reliable alternative system in place that provides the same information in a suitably timely manner. For example, the need for an on-ground hail system is inversely related to the reliability and effectiveness of the logbook system in place.

Dockside monitoring

Dockside monitoring is the responsibility DFO, and is used periodically in the commercial salmon fisheries to provide information on kept catch, average fish weight and bio-samples.

Issues

- Partial dockside monitoring, as a supplement to other tools, can provide the information on mean fish weight and bio-samples, but may be unreliable regarding the total salmon caught. This is due to the wide variation in average harvests in salmon fisheries, and the uncertainty regarding the proportion of coverage achieved in a given fishery.
- Mandatory dockside monitoring program, even though it would not directly rely on the active co-operation of fishermen, may be logistically difficult to implement and police. This is due to the nature of the salmon fishery, including its wide geographic range, the concentration of fish landings in short time frames, and the diversity of landing sites. The resulting costs of a mandatory monitoring program may be relatively high compared to other fisheries.

Appendix 8. Individual records of unexpanded sockeye catches for those vessels and vessels-days with all records (observer, logbook phone-ins / mail-ins and sales slips), 2000 South Coast commercial fisheries (data as of Dec. 31, 2001).

				SOCKEYE CATCH			
Gear	Area	Vessel #	Record Date *	Observer Records	Logbook Phone-ins	Logbook Mail-ins	Sales Slips
SEINE	B	1	14-Aug-2000	3	3	3	
		1	15-Aug-2000				6
		1	21-Aug-2000	473	473	473	405
Total Seine B				**476**	**476**	**476**	**411**
GILLNET	D	2	09-Aug-2000	198	198	198	
		2	10-Aug-2000	94	94	94	289
		Subtotal 2		**292**	**292**	**292**	**289**
		3	14-Aug-2000	3	3	3	
		3	15-Aug-2000				1
		Subtotal 3		**3**	**3**	**3**	**1**
		4	02-Aug-2000	110	100	100	
		4	03-Aug-2000	79	79	79	176
		Subtotal 4		**189**	**179**	**179**	**176**
		5	19-Jun-2000	96	96	96	96
		6	19-Jun-2000	152	152	152	152
Total Gillnet D				**732**	**722**	**722**	**715**
GILLNET	E	7	10-Aug-2000	281	281	281	229
		8	26-Jul-2000	339	339	339	
		8	27-Jul-2000	22	22	22	361
		8	09-Aug-2000	213	213	213	
		8	10-Aug-2000	87	87	87	300
		Subtotal 8		**661**	**661**	**661**	**661**
		9	21-Aug-2000	65	65	65	46
		10	09-Aug-2000	1040	900	800	
		10	10-Aug-2000	477	611	711	1,247
		Subtotal 10		**1,517**	**1,511**	**1,511**	**1,247**
Total Gillnet E				**2,524**	**2,518**	**2,518**	**2,183**

cont'd

Appendix 8. (continued)

				SOCKEYE CATCH			
Gear	Area	Vessel #	Record Date *	Observer Records	Logbook Phone-ins	Logbook Mail-ins	Sales Slips
TROLL	G	11	21-Jun-2000	37	37	37	
		11	23-Jun-2000				33
		Subtotal 11		**37**	**37**	**37**	**33**
		12	02-Aug-2000	7	7	7	
		12	03-Aug-2000	12	12	12	
		12	04-Aug-2000	89	89	89	
		12	05-Aug-2000	76	76	76	
		12	06-Aug-2000	89	89	89	
		12	07-Aug-2000	25	25	25	319
		Subtotal 12		**298**	**298**	**298**	**319**
		13	11-Aug-2000	11	11	11	
		13	12-Aug-2000	2	2	2	
		13	14-Aug-2000	3	3	3	
		13	15-Aug-2000	1	1	1	
		13	16-Aug-2000	8	8	8	
		13	17-Aug-2000				27
		Subtotal 13		**25**	**25**	**25**	**27**
		14	09-Aug-2000	12	12	12	
		14	10-Aug-2000	19	19	19	
		14	11-Aug-2000	8	8	8	
		14	12-Aug-2000	7	7	7	
		14	13-Aug-2000	2	2	2	
		14	15-Aug-2000	1	1	1	
		14	16-Aug-2000				52
		Subtotal 14		**49**	**49**	**49**	**52**
Total Troll G				**409**	**409**	**409**	**431**

* Record date represents date of fishing for observer and logbook records, and date of landing for sales slip records.

Appendix 9. Comparison of expanded observer and logbook catch estimates by species and Licence Area, South/Central Coast commercial salmon fisheries, 1999 and 2000.*

		1999				2000			
Gear	Area	Observer	Logbook phone-ins	Diff.	% Diff. **	Observer	Logbook phone-ins	Diff.	% Diff. **
SOCKEYE -- retained									
Seine	B					309,739	303,207	6,532	2%
Gillnet	D	70,168	72,352	-2,184	-3%	161,564	157,173	4,391	3%
Gillnet	E					513,488	424,555	88,933	17%
Troll	G					28,437	24,763	3,674	13%
Troll	H	15,538	12,634	2,904	19%	56,659	55,167	1,492	3%
PINK -- retained									
Seine	B					1,748,626	1,205,629	542,997	31%
Gillnet	D	834	996	-162	-19%	144,352	117,317	27,035	19%
Gillnet	E	28	32	-4	-14%	40	24	16	40%
Troll	G	34	20	14	41%	29,577	31,740	-2,163	-7%
Troll	H	2,252	2,408	-156	-7%	47,581	40,735	6,846	14%
CHUM -- retained									
Seine	B					110,882	126,091	-15,209	-14%
Gillnet	D	85,020	87,390	-2,370	-3%	27,556	30,632	-3,076	-11%
Gillnet	E	173,423	142,249	31,174	18%	5,235	5,524	-289	-6%
Troll	G	1,634	1,674	-40	-2%	181	493	-312	-172%
Troll	H	178	288	-110	-62%	3,225	1,568	1,657	51%
CHINOOK -- retained									
Seine	B					22	28	-6	-27%
Gillnet	D	202	144	58	29%	186	594	-408	-219%
Gillnet	E	164	37	127	77%	6,029	4,302	1,727	29%
Troll	G	65,965	56,414	9,551	14%	20,437	23,607	-3,170	-16%
Troll	H	422	232	190	45%	554	546	8	1%
CHINOOK -- released									
Seine	B					3,317	2,096	1,221	37%
Gillnet	D	106	84	22	21%	435	152	283	65%
Gillnet	E	141	52	89	63%	187	192	-5	-3%
Troll	G	30,939	15,428	15,511	50%	16,683	11,598	5,085	30%
Troll	H	166	99	67	40%	264	275	-11	-4%
COHO -- released									
Seine	B					7,305	5,954	1,351	18%
Gillnet	D	1,411	840	571	40%	5,373	3,268	2,105	39%
Gillnet	E	837	243	594	71%	284	145	139	49%
Troll	G	2,743	3,281	-538	-20%	7,654	7,292	362	5%
Troll	H	153	51	102	67%	1,014	686	328	32%
STEELHEAD -- retained & released									
Seine	B					150	117	33	22%
Gillnet	D	1,105	377	728	66%	709	474	235	33%
Gillnet	E		14	28	67%				
ATLANTIC - retained									
Seine	B					1,866	1,775	91	5%
Gillnet	D					6,164	5,262	902	15%
Gillnet	E					0	231	-231	-
Troll	G					29	28	1	3%

* Data from Summary Reports (Fisheries and Oceans Canada 2000, 2001). Observer and logbook data pairs that totaled fewer than 30 fish were omitted.

** % Difference = Percent of (Observer estimate - Logbook estimate) / Observer estimate.

Appendix 10. Comparison of expanded observer and logbook catch estimates by species, South/Central Coast commercial salmon fisheries, 1999 and 2000.*

Species	Expanded Observer	Expanded Logbook	Difference (Obs-Log)	% Diff. **
Sockeye	70,168	72,352		
retained	15,538	12,634		
	309,739	303,207		
	161,564	157,173		
	513,488	424,555		
	28,437	24,763		
	56,659	55,167		
Total	1,155,593	1,049,851	105,742	9%
Chum	85,020	87,390		
retained	173,423	142,249		
	1,634	1,674		
	178	288		
	110,882	126,091		
	27,556	30,632		
	5,235	5,524		
	181	493		
	3,225	1,568		
Total	407,334	395,909	11,425	3%
Coho	1,411	840		
released	837	243		
	2,743	3,281		
	153	51		
	7,305	5,954		
	5,373	3,268		
	284	145		
	7,654	7,292		
	1,014	686		
Total	26,774	21,760	5,014	19%
Steelhead	1,105	377		
retained	42	14		
& rel'd	150	117		
	709	474		
Total	2,006	982	1,024	51%

Species	Expanded Observer	Expanded Logbook	Difference (Obs-Log)	% Diff. **
Pink	834	996		
retained	28	32		
	34	20		
	2,252	2,408		
	1,748,626	1,205,629		
	144,352	117,317		
	40	24		
	29,577	31,740		
	47,581	40,735		
Total	1,973,324	1,398,901	574,423	29%
Chinook	202	144		
retained	164	37		
	65,965	56,414		
	422	232		
	22	28		
	186	594		
	6,029	4,302		
	20,437	23,607		
	554	546		
Total	93,981	85,904	8,077	9%
Chinook	106	84		
released	141	52		
	30,939	15,428		
	166	99		
	3,317	2,096		
	435	152		
	187	192		
	16,683	11,598		
	264	275		
Total	52,238	29,976	22,262	43%
Atlantic	1,866	1,775		
retained	6,164	5,262		
	0	231		
	29	28		
Total	8,059	7,296	763	9%

* Data from Appendix 9.

** % Difference = Percent of (Observer estimate - Logbook estimate) / Observer estimate.

Appendix 11. Comparison of average sockeye weights (lbs) based on sales slip data and MRP data.*

			Sales Slip Data		MRP Data		
Gear	Licence Area	Statistical Week	Avg. Wt.	No. pieces	Avg. Wt.	No. fish counted	Difference (SS - MRP)
Seine	B	064	5.37	1,668	5.64	100	-0.27
		082	5.72	63,603	6.30	700	-0.59
		083	5.74	599	4.61	179	1.13
		084	5.93	8,786	6.21	107	-0.29
Gillnet	D	064	5.21	6,554	5.65	100	-0.44
		071	5.31	4,392	5.48	495	-0.17
		074	5.90	892	5.91	350	-0.01
		075	6.03	6,505	6.06	379	-0.03
		081	6.06	97,504	6.10	7,877	-0.04
		082	6.04	86,102	6.00	8,256	0.04
		083	6.17	42,664	5.99	5,016	0.18
		084	6.73	580	6.57	70	0.16
		091	7.37	2,184	5.04	170	2.33
Gillnet	E	075	6.08	222,251	6.32	357	-0.24
		082	6.05	260,414	6.00	3,372	0.05
		084	6.31	13,613	5.83	12	0.48
Troll	H	082	5.40	47,735	6.30	12,706	-0.90
		083	5.61	34,384	5.88	2,117	-0.27

* Data from Table 16.